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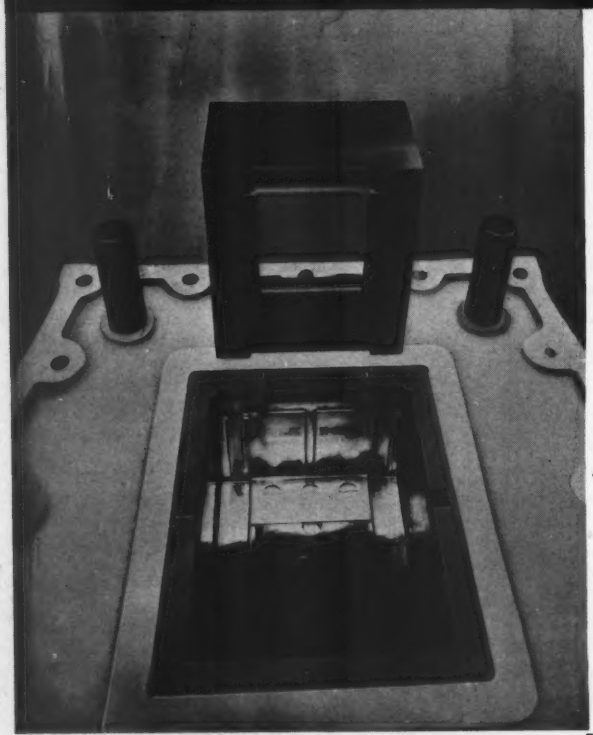

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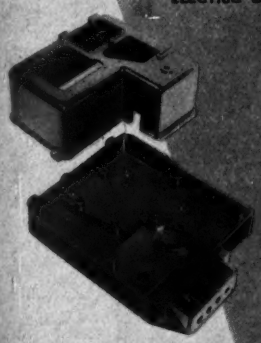

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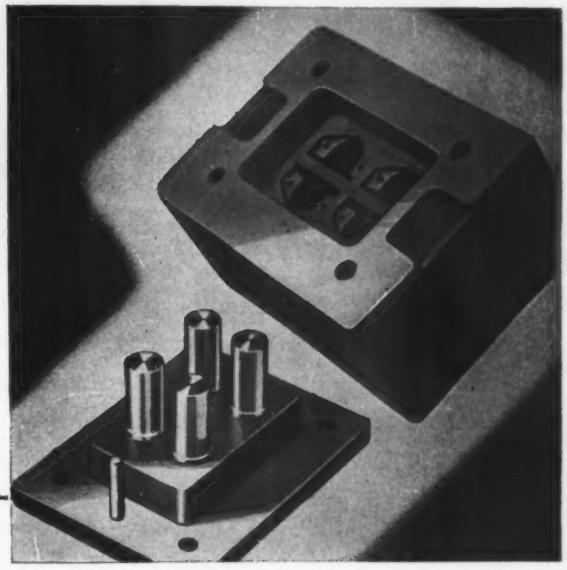

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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials.

Vol. III. OCTOBER, 1939 No. 29

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Vol. III. No. 29 OCTOBER, 1939

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

Editor - - M. D. CURWEN, B.Sc., A.I.C.
Offices - Bowling Green Lane, London, E.C.1

WANTED—A LIAISON OFFICE

THERE is, and there will continue to be as long as war lasts, a metal difficulty. Copper and brass, except for war materials and other special products, will be almost prohibited for unessential purposes; steel, tin, aluminium, lead and other metals will be difficult to obtain.

Soon there will be, if it has not already happened, a rushing to and fro by industry, first trying to get metals by hook or by crook, and, secondly, discovering what, if anything, can replace metal for certain manufactures. It is high time that we took a leaf out of Germany's book and replaced metals by plastics; not for almost every conceivable purpose, merely because of the lack of metal, but where they can be employed with advantage.

There are now two aspects of the problem, plastics v. metals.

The first has always been foremost in the policy of this journal. We state without fear of contradiction by the metal industry that there are certain finished goods of metal which can be replaced with economic and other advantages by plastics, because of their very chemical and physical properties and because of their ability to be moulded.

Plastics are limited in their application. You cannot have a bridge made of them because the strongest plastics are not yet as strong as steel and we cannot mould very large pieces. You cannot have a boiler made of plastics because they will not have the strength of steel, nor will they stand up to boiling water for years on end, nor are they good conductors of heat. You cannot have a lightning conductor of plastics because plastics are non-conductors.

But you can have an acid and dye tank made of plastics because plastics will withstand acids and not affect dyes if they are not kept at too high a temperature.

You can have a gear wheel or bearing made of plastics instead of metal and it will last longer and weigh less.

You can have a lamp switch of plastics instead of brass. Plastics are insulators and never require cleaning. You can have a coat hanger or door knob or a hundred and one other fittings normally of metal made from plastics and they will serve the purpose better in many ways. You can have a pair of weighing scales moulded of plastics instead of metal and give a clearer and more pleasing result. You can have a water closet tank of plastics which will stand up better to corrosion than metal tanks.

Most important of all, you can have certain objects made of plastics instead of metal and give better results in the economics of manufacture merely because plastics are mouldable. It is easy to visualize a complicated metal object which is composed of, say, three or four separate stampings, welded or screwed or punched together because the object cannot be made out of one piece. That object can probably be made in one moulding shot from plastics complete without the necessity of cleaning or plating to preserve its surface.

A famous American business man in the metal industry said a year or two ago, when dealing with the "plastics versus metal" controversy: "On a tonnage basis there is no serious threat at present, but for a multitude of small objects, plastics, in combination with metals under a newly developed fabricating process, offer a formidable challenge to metals used alone, as well as to other materials in combination. Further, due to the design possibilities of plastics and the importance of appearance in utility products, it seems as if nothing can stop a rapid advance in the use of metals as a strength aid to plastics, or in the use of plastics as an appearance aid to metals.

"The threat is not so much to the producer of raw materials or half-finished metals as to the fabricator. *Either the metal fabricators must take over plastics and adapt them to their use, or the plastics fabricators will take over metals* (the italics are ours). The producer will do well to consider the combination of plastics and metals in his new design, and perhaps even to consider absorbing an added fabricating operation."

He gave a good example as an illustration of his argument. "The motorcar door handle of the electroplated zinc die-casting type frequently passes through 14 processes from the rough cast to the finished job. The injection moulded job using plastics eliminates nearly all these processes."

The second aspect of plastics v. metals is one

peculiar to war, and merely due to shortage of metal. It may be that there will be attempts to use plastics where they are not suitable. Even though such a step be a temporary one, it is a dangerous procedure and may do harm to the plastics industry.

We have always been furious with the Government over one special job which should have been made in plastics and would have saved a great deal of metal. We refer to the "tin" helmet. Let us admit that for the soldier it must be made of sheet steel, although there are arguments against even that, for a "tin" helmet will not stop a bullet. But hundreds of thousands have been issued to the police, to the A.F.S., to Air Raid Wardens and to those in the Army who will be at home and in the rear of the front line; many have been sold to the public. None of these will be exposed to anything more than the results of our own anti-aircraft fire, to the danger of falling masonry, etc. And for this purpose the helmet made from moulded synthetic resin is admirably suited and has long been tested out with successful results in mines. We should say that anything between 1,000 to 2,000 tons of steel has been wasted because of lack of understanding of plastics in this example alone.

Both aspects, therefore, need careful consideration and guidance should be available from a properly constituted body for the benefit of metal manufacturers and factors. Such an advisory body or system of liaison officers should, of course, be set up by the Government for it is in the Government's interest to conserve metals. Scientifically and in the interest of the economics of the nation, it is an urgent necessity.

Happily there is in the new Ministry of Supply a small section which concerns itself with plastics. A group of engineers and chemists with a special knowledge of plastics, of its potentialities and of the requirements of outside industry working within this cell could be of immense help to the nation.

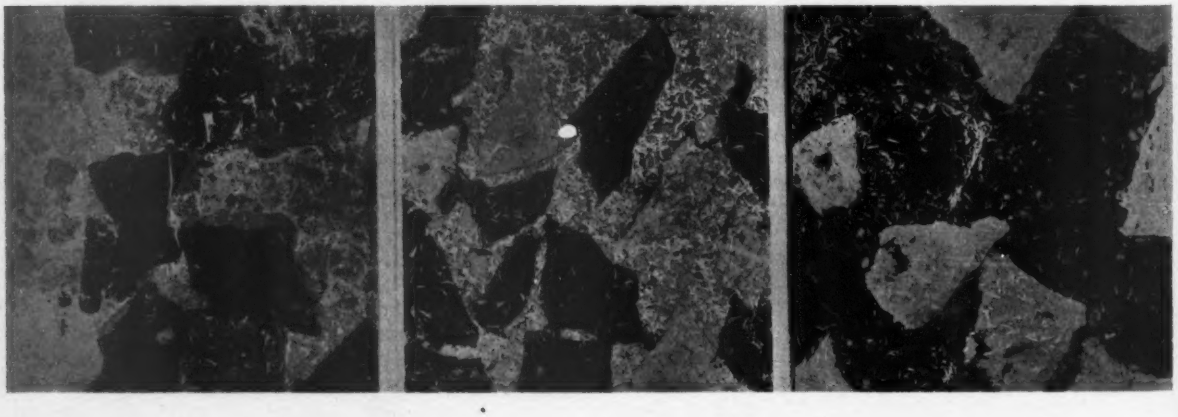
OROBELLO

THERE is about to come on the market, or at least we hope there is, a very beautiful new plastic for decorative purposes. Whether it will do so, during such times, is in the laps of the gods. We can well imagine our dear friend Mars, who is now G.O.C. Gods, grinning down sardonically and saying, "What? Orobello. Don't make us laugh! Now if you have a nice new line in bombs or poison gas we might consider it. As it is, close the door as you go out." Still, we have our hopes.

Orobello is the invention of an Italian, a Mr. de Faveri, and looking at the material one can almost say it could only be the invention of an Italian, for coloured mosaic and Italy are almost synonymous.

Mr. de Faveri has been able to obtain in moulded sheet form (generally about $\frac{1}{8}$ in. thick) an effect which in beauty and warmth of colour far transcends any mosaic we have yet seen. This appears to be strong language, but the material is very beautiful. The photograph below does give an idea of the mosaic form. Unfortunately, it is merely a black and white photograph and gives no idea of the beautiful lapis lazuli, dark green, black or golden brown which make the material so lovely. Moreover, there will be seen in the photograph tiny white flecks. Actually the material looks as if it were flecked with brilliant metallic gold. Presumably metallic filings have been incorporated in the moulding mixture. The inventor claims that Orobello, in addition to being the perfect material for wall-panelling, counter tops and ordinary mouldings, is eminently suitable for the construction of parquet and dance floors, radio cabinets, pianos and the decoration of ocean liners and motorcars. Like other types of plastic material, it can be worked in a variety of ways. It can be sawn, tapered and threaded to take screws as well as milled. An interesting characteristic of the material is its high resistance to flame, and no mark is made on leaving a lighted cigarette on its surface for several minutes. Presumably, this property is given it because of its metal content. A closer examination of the material reveals some interesting facts. It is, in a sense, made up of two layers, and in the sample examined these were approximately 1-16 in. in thickness. The bottom layer is apparently made up of a non-coloured cotton or other cellulose material impregnated with a phenol-formaldehyde resin, probably by means of solution. The top layer gives the coloured mosaic effect and, without wishing to delve into the secrets of the process, appears to be made up of, say, pieces of coloured resin, probably only partly polymerized, and arranged in mosaic form on to the bottom layer before the final pressure is applied.

In addition to metal particles, Mr. de Faveri employs leather waste or broken china to get special effects. He also claims that the material is as cheap as the ordinary phenolic resin powders. This may be so, weight for weight, but we should like to ask whether or not the slab or sheet form can be made as thin as laminated veneers, say, 1-32-in. thick? If manufacture is possible only in $\frac{1}{8}$-in. thickness, this means increased cost to the user. However, one can fairly say that this beautiful plastic can demand its own price.



How Fares the Plastics Industry?

IT is far too early to give any details as to how the plastics industry has reacted to war conditions. A comprehensive view will only be possible after some lapse of time, and for this our readers must hold themselves with patience. From time to time we shall endeavour to collect information regarding changed conditions under, broadly speaking, four headings:—

(1) Manufacture to Government orders.

(2) Manufacturers as affected by cessation of supplies from Germany.

(3) Manufactures of new plastic goods due to limitation of non-plastic raw material supply.

(4) State of manufactures of peace-time goods.

Of the first there will be little to say until such time as permission were given by the Government for the release of information which is often on the secret list. Under the second heading there should be interesting developments as and when business settles down. A considerable import business of plastics raw materials and finished goods was carried on from the Continent, and already there has been a big demand by certain trades whose supply of goods, sometimes of the cheap, cut-price variety, is being cut off. In one instance—that is, in bottle-caps—the result is something in the nature of just retribution. This is very much a ruthless business, and large imports from Germany supported, it is claimed, by subsidies caused many British manufacturers, who refused to manufacture at no profit, to quit the game. Now they are being inundated with requests. Many have thus no stock moulds, but luckily those who have held to reasonable prices and were able to manufacture by utilizing the latest machines are reaping some profit. Perhaps, after all, some benefit to the plastics industry may appear out of all this mess, and convince both buyers and sellers that ruthless price-cutting does not pay.

There is bound to be, if war is unfortunately prolonged, a great opportunity to enter certain manufactures, which have been the prerogative of the metal trade, owing to lack of metals. This process has, of course, been going on slowly ever since the plastics industry began, but the rate will be much greater.

It is equally important that as far as possible manufacturers should retain their hold on normal every-day business, for in many ways it is almost as vital to the nation's economy as is armament work.

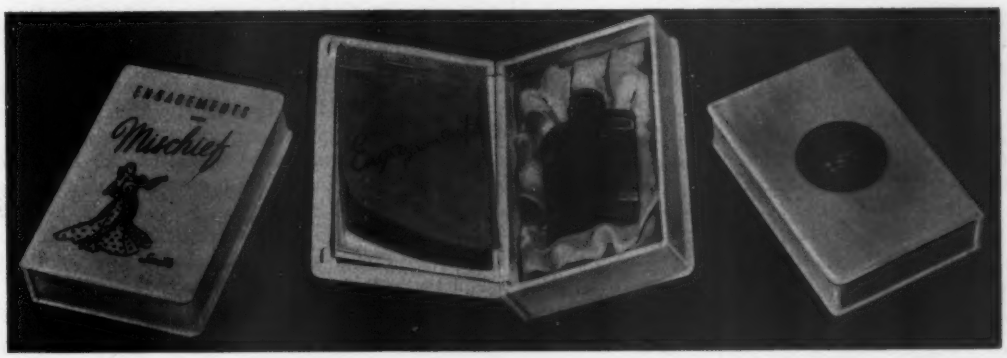
The main point to note is that after the first weeks of shock and disarrangement the plastics industry has discovered that it has a busy time in front of it, although whether it will be a very prosperous one remains to be seen. Most factories are doing some war work, and many have retained some portion of their peace-time jobs. Surprising to some, but not to the psychologists, certain portions of the fancy goods trade have not only been not wiped off the map, but are very busy. Some luxury trades have almost experienced a little boom. Perfumes and face powders and creams are even more important now than ever to women, so the psychologists tell us. The plastics industry will reap some benefit.

Here are some of the impressions we have gained so far in the first month and some indications of what moulders and others are fabricating. The number of factories visited so far is necessarily small, but we shall issue further reports as time goes on.

Rootes Mouldings, Ltd., Slough.—This was one of the earliest we visited—in fact, during the second week of war—so that transport difficulties were much to the fore. Mr. Rootes and Mr. Garrett informed us that it seemed as if at least 30 per cent. of their work is going to be Government work, and this was, of course, very hush-hush. As for ordinary jobs, these were coming in steadily, especially a new type of razor holder for a very large concern. Orders for old-type razor boxes are very large and promise to be larger still. This concern, as readers know, are experts in metallizing plastics. Mr. Rootes is carrying out research work on the coating of plastic containers with metal for certain radio work at present carried out solely in metal.

British Artid Plastics, Ltd., Slough.—A good indication of how certain peace-time jobs are being continued, especially in the perfume industry, as we have already indicated above, is the new order for the Saville Perfumery Co. which British Artid Plastics, Ltd., are now delivering. It is the new "Mischief" case in the form of an engagement "book" carried out in lovely cream-coloured amino-resin. On the cover of the book is a deep etched design, and on the inside of the cover is an engagement note-book. Within the case itself rests the scent bottle, and on the back cover is a second deep etched design showing a top-hatted Cupid complete with bow and arrow.

Other interesting mouldings recently carried out by the same firm is an "engraved" knob for a new weighing machine, the Flexomatic, made by the famous firm of W. and T. Avery, Ltd., and a switch for a special electric device. This latter is seen in the centre of the photograph overpage. In the picture the device which is moulded from amino plastics, does not look very exciting. It is, nevertheless, an excellent example of high precision work. The third object seen in the same photograph is purely experimental, and but for



Saville's New Pack for "Mischief" Perfume.

Examples of the work of British Artid Plastics, Ltd.

the hard-heartedness of the G.P.O. would, with the requisite lettering, adorn our telephones. Again moulded from ivory amino plastics, with the figures very deeply cut, it was suggested as a replacement of the ordinary enamelled metal plate. This would have proved an excellent substitute for metal, the figures and letters on which eventually become obliterated.

British Artid Plastics, Ltd., are doing a considerable proportion of Government work—about 50 per cent. of their total.

Insulators, Ltd., London, N.18.—Mr. Waghorn was in optimistic mood when we called and said he was fairly confident that, apart from difficulties due to lack of staff, the company would be very busy and carry on even better than before. About 70 per cent. of the work carried out will probably be for the Government.

London Moulders, Ltd., Wembley.—Both Mr. Vernon Spencer and Mr. Steel were convinced that the difficulties of the past were being smoothed over and that the plastics industry as a whole will have a sufficiency of work. This, like almost every other concern we visited, is doing a considerable proportion of war work and is not marking time on normal work. Moreover, they have several new ideas in hand, of special interest being one which is really a war-time job. It is a cellulose-acetate injection-moulded identity disc of original design for public use. As will be seen from the photograph, a central recess holds the name and address written on

London Moulders, Ltd., are making this identity disc.

a circle of paper or a photograph. This is then protected by a circle of acetate, which is snapped into position. Worn on the neck, wrist or anklet, the young ladies of the town should be able to remember who they are anywhere and at any time.

Hadley Co., Ltd., Surbiton.—This is the busiest factory we have yet seen. As most readers will know, it is probably the largest and best-known concern in the optical trade and their experience in sheet-plastic manipulation soon led, some years or so ago, to cellulose-acetate shaping for aeroplanes and for bullet-belt conveyors and guides. This, in addition to goggle manufacture for soldiers and their normal spectacle work, which has, if anything, increased, has forced the company to expand their working space greatly. To give some idea of the magnitude of some of the orders that are now going to the acetate shaping and cutting trade, we have just heard that 12 such manufacturers are to share a new order for 14,000,000 goggles or, rather, visors. Each soldier carries a stock of six, which may need (we hope not) replacement. This visor is made of thin acetate sheet with an area of, roughly, 16 to 20 sq. ins. To save you calculation, the order will need between 170,000 and 220,000 sq. yds. of acetate sheet!

As we have already indicated, the Hadley Co., Ltd., still have their large spectacle business going strongly. Furthermore, they are in process of manufacturing a new industrial goggle of acetate.

Precision Plastics, Ltd.—This Birmingham company is very busy now, its special pet at the moment being a moulded gas-mask container of original shape. The shallow design appears eminently practical. This is probably not the only attempt that is being made to provide a long-felt want; in view of the fact that gas masks are being carried continually, a rubber or rubber-like case is probably the best solution. Ability to stand knocks and flexibility are highly desirable.

Catalin, Ltd., Waltham Abbey.—At first sight it would have appeared that this concern, who manufacture Catalin and who really put cast phenolic resin on

A moulded gas-mask container by Precision Plastics, Ltd.

the industrial map in this country by means of a very thorough and intensive advertising campaign, would suffer considerably in war-time because cast resin must be classed in the luxury section of the plastics industry. The classification may be correct, but there is little sign within the factory at Waltham Abbey that there has been much slowing down. During our visit most of the stills were working turning out the glass-clear resin and the lead moulds were being filled as rapidly as the stills were emptied. To begin with, this factory has some excellent business in turning out the rough shapes for cutting into army toothbrush handles. These shapes are polished, drilled and fitted with the bristles by Catalin customers. Then, again, we saw stacks of the largest mouldings of cast resin we have yet seen in this country. Annular in form, they are to make about 1,000 lavatory seats for the new "Queen Elizabeth." While talking with Mr. Marti on the prospect of maintaining non-army work, he showed us the new Catalin taps that were being moulded for the Ascot heater, replacing a non-plastic tap. He also agreed that there would be a tendency to drop brass in favour of plastics and showed me two examples of this they were already doing—a new curtain clip and curtain rings in a big variety of colours.

(We shall continue with this type of news in our next issue.)

Our Raw Materials

A few random and simple notes for the delectation of fabricators collected with the express purpose of clearing up certain questions that have been put to us

IN the strenuous days that have just passed, we have all known trying times and we have all learned without exception what sudden lack of raw materials means. We have also learned that the raw material for our industry is not only that which makes the finished goods we sell, but also the keg or box or paper in which it is packed, the labels we stick on the kegs, the transport in which it is carried, the very petrol by which the transport becomes available and, lastly, but by no means least, the human element which makes the goods, which fills the keg, which sticks the label and which drives the lorry, to pay for the taxes on the House that Jack built. Should one of these links be missing, and how often it has happened during the past month there is no need to tell, then foam at the mouth as you will, the system breaks down.

However, things will and are, in fact, settling down more smoothly already and we have learnt the trick of getting priority deliveries by quoting mysterious Admiralty, Air Ministry and War Office numbers.

The purpose of these notes is not to tell readers how to deal with the daily worries of every works manager, although that would never come amiss. It is rather to discuss in broad outline what is in every works manager's mind to-day. How shall we be affected in the future with reference to deliveries of the real raw materials of the industry? May we say here, with due respect to the moulding industry, which frankly is at present purely an engineering industry, that here is a good chance to realize what the whole plastic industry entails. We believe that such a knowledge will help the industry in the days ahead. By this we do not mean that a chemical knowledge of the structure of the phenol-formaldehyde resin molecule will help you to run your presses better. But we do believe that a more intimate examination of the source of our raw materials will prevent a lot of headaches in apportioning the blame for shortage of them or increases in prices, if any. In any case, even if the discussion is merely an academic one, it is nevertheless interesting.

Now, our industry employs phenol-formaldehyde resin, cast, powders and solutions, urea-formaldehyde powders and solutions, celluloid and cellulose acetate, the latter in powder or sheet form, the regenerated cellulose for wrapping "paper," casein, "acrylic" resins, "styrene" resins, "vinyl" resins, synthetic rubbers, natural and treated natural rubber, bitumen and many others.

Let us deal with the source of these seriatim. While it is too early to note any drastic change at present in supplies, we hope to note them in our future issues. It is also important to consider which other industries use our raw materials.

Phenol-formaldehyde Resins

The raw materials in this section are phenol, cresylic acids, formaldehyde and, in the case of moulding powders, fillers such as wood flour, asbestos, cotton, paper, etc. The solutions are usually solutions in alcohol.

Phenol or carbolic acid is in this country almost solely obtained from coal tar. It can also be made synthetically from benzene, which is extracted from coal gas. The situation regarding supplies of phenol is more than usually interesting compared with the war of 1914. Then the great proportion of phenol was used for the manufacture of picric acid explosive made by treating phenol with nitric acid. In fact 71,000 tons of picric acid were made during the four years and this necessitated at least 30,000 tons of phenol or about 600 tons of phenol per month. In addition to many factories producing the coal tar phenol, there were seven producing the synthetic variety. Thus the country, when pushed, was able to produce enormous quantities of the material. The synthetic resin industry did not to any extent exist then. The phenol was all employed for making picric acid explosive, for dyestuffs (not on a very large scale as our dyestuffs industry was only getting into its stride) and as a disinfectant.

To-day the picture is very different. One person I questioned a few weeks ago on this subject suggested there would be no phenol for the plastics industry because it would all be taken for the picric acid industry. I think he was very much mistaken. I do not believe the picric acid industry is of any size if it exists at all. Picrid acid is a back number as regards explosives, being replaced by T.N.T., Ammonal and the new ones that have come along since.

The danger of lack of supplies is elsewhere. Our dyestuffs and our drug industries are very large now and use considerable quantities of phenol. It is also used for making cyclohexanol and synthetic perfumes. Another large use is in making aspirin and similar compounds, and in recent years, by ingenious advertisement, aspirin has become a panacea for all ills from ingrowing toenails to making flowers grow once they have faded. The quantities of aspirin tablets made are enormous. It would not be much of an exaggeration to say that every family in the United Kingdom possesses a bottle they could well do without. The industry probably consumes about 500 tons of phenol per annum. But even this is small compared with what the country can do. On the whole there seems very little likelihood of a shortage. There is in addition to the natural supplies at least one existing plant which can produce the synthetic variety. It is even probable that there is little need to make synthetic phenol if the above statement regarding the elimination of picric acid as an explosive is true. Moreover, the benzene required for making phenol would probably be diverted by the Government to fuel production, the manufacture of aniline and the many other benzene compounds used for dyestuffs and drugs which are generally considered almost as important as explosives during war time. More exact information will be published later.

Cresylic Acids.—Like phenol, these are produced by the distillation of coal tar. Large quantities of certain cresylic acids are used for the manufacture of "phenol"-formaldehyde resins for moulding powders, although they cannot be considered as good as the pure phenol type. Large quantities of the resin are also employed for making paints and varnishes. There is little likelihood of a shortage of cresylic acids as their use in other industries, for making dyestuffs, soap solvents, disinfec-

tants, etc., is not considerably increased during war time. Were it a fact that there existed a shortage of phenol, more cresylics might be employed. There is also a source of supply of cresylics from the low-temperature carbonization of coal. These have, in peace times, been considered unsuitable for moulding powders owing to slow curing properties. As a last resource they could readily be employed.

Formaldehyde.—The almost universal method of manufacture is by passing the vapour of methyl alcohol and air over hot copper wire or similar catalytic process. The methyl alcohol is obtained by the dry distillation of wood, and now on a very large scale synthetically by the interaction between carbon monoxide and hydrogen (water gas) at high pressures and temperature. It is difficult to see any possible shortage in formaldehyde. There is no direct use as a war material, but it is widely used as a disinfectant in ordinary life and in industry, in the making of dyestuffs, for hardening glues and gelatine, in textile manufacture and, of course, for hardening casein.

Wood Flour.—A great proportion of moulding powder consists of wood flour, most of which comes from Scandinavia. There is a real danger of shortage if Scandinavian ships are prevented coming to this country. Happily, a few British concerns started production a few years ago with considerable success.

Asbestos.—None is found in this country. All is imported from Canada and the Transvaal.

Paper.—All wood pulp for paper making is imported from Canada, Finland, Sweden, etc.

Amino Resins

Urea.—This chemical, which forms the chief source of our amino resins by heating with formaldehyde, is made from ammonia and carbon dioxide in very large quantities. As both gases are readily available in unlimited quantities, there seems no possibility of shortage of urea resins.

Cellulose Plastics

All these plastics depend almost solely on cotton and wood pulp as their raw material. The nitric acid and acetic acid necessary to convert them into celluloid or cellulose acetate are available in unlimited supplies. The cotton and wood must be imported.

Much work has been carried out on the possible use of poor-grade wood, straw, etc., for conversion into pure cellulose. Such production would relieve in part the necessity of using cotton.

Even though cotton be freely imported, and there is every hope that our command of the sea will permit it, the danger to the plastics industry lies in the fact that enormous quantities are employed for making cordite and guncotton and for textiles. I believe British Celanese have a patent for treating straw or some such material. We wish them luck for their foresight.

Apart from British and French supplies, American cellulose plastics are available. The Nixon Nitration Works, of Nixon, New Jersey, U.S.A., are advertising this fact in this issue of *Plastics*.

Acrylic Resins

The only resin of this type in this country is Perspex, made by I.C.I., Ltd. Since this resin is made, so to speak, from coal and air originally, no imported material is required. We have as yet made no inquiries as to available supplies. Normally, considerable quantities are used by the Royal Air Force.

Poly Styrene Resin

Again we have only one or two manufacturers in this country. Unfortunately, the production, having begun only a year or two ago, is not large, and probably could not yet supply the total requirements. We hope that they will increase rapidly and satisfy the demands of the industry, which hitherto came almost entirely from Germany. Some quantities have been imported from France.

For the time being we fear that little will be available for work other than Government contracts. On the other hand, the raw materials being benzene and alcohol, we are not dependent on outside sources for them.

Vinyl Resins

Nearly all was imported into this country, vinyl acetates (Alvars, etc.) from Canada and vinyl chlorides (Mipolam, etc.) from Germany and Koroseal (U.S.A.). The latter rubberlike synthetics made from acetylene are particularly useful for cable work, but it is stated on good authority that the new British "ethylene" polymer Polythene has definite electrical advantages over the vinyl chlorides. The production of Polythene, however, although now on a manufacturing scale, is not yet very large.

There is this to say of these compounds generally: their uses are at present limited and specialized, so that rubber and gutta-percha could be employed for the duration of war as heretofore without much disturbing the industries involved.

Casein Plastics

The raw material casein is produced by the action of rennet on milk. Fairly large quantities are produced in this country, but most of it is imported from the great agricultural countries, France, Argentine, etc. It will be interesting to see how far the casein plastics industry will be allowed to exist, or whether the Government will collar all supplies for food or glue purposes.

Casting Phenolics Without Heat

Normally, cast phenol-formaldehyde resins are maintained for long periods at fairly elevated temperatures before they harden to the finished condition. The maintenance of thermostatically controlled ovens of very large size has contributed to the comparatively high price of the material. We understand that the Marblette Corporation of U.S.A. has announced a new liquid resin for casting which can be hardened without heat or pressure by the addition of special accelerating agents. The new resin, Quick-Set resin No. 2, is obtainable in black and ivory for casting in rubber, lead and glass moulds. It solidifies in 24 to 48 hours without heat.

A similar resin is available for use as an adhesive for joining most plastics and for impregnation of wood, cloth and paper.

Important Notice

We bring to the notice of our readers that, owing to war-time restrictions, *Plastics* will only be obtainable to order and that newsagents will no longer hold copies for chance sale as heretofore.

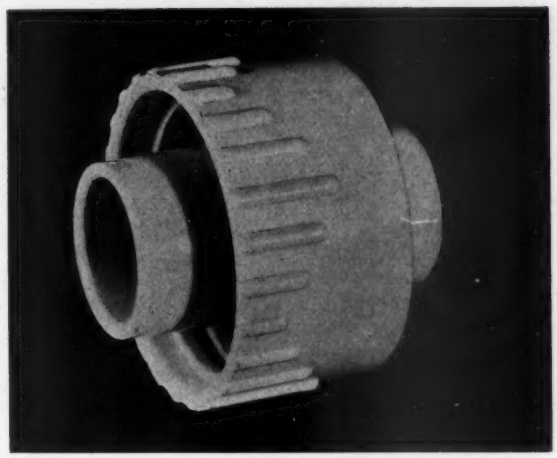
Any readers who have given newsagents orders to deliver or reserve copies of *Plastics* and have difficulty in receiving it regularly should communicate with this office so that we may rectify the matter.

Ideas—

By the EDITOR

Measuring Stoppers

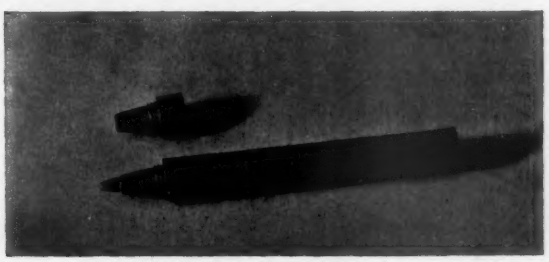
I have had this photograph for some time, but it was not published in these pages for some reason I have forgotten. However, I do know that the idea is for medicine or similar bottles, so that a dose can be measured fairly accurately in the central tube of the stopper. It seems natural to suggest the idea for other types of stoppers, such as the large ones used for sugar



or flour canisters. A central cavity to hold an ounce of material might be useful to housewives who have no weighing machines.

A Novel Pencil

A few days ago a Mr. Jeffreys entered my office and, without any preamble, handed me a pencil. I promptly had a photograph taken of it. As an idea I think it is as new as any I have ever come across. In the patent specification he modestly claims that the primary object is to provide a pencil cheaper and simpler to manufacture than the usual propelling pencil. This statement is worthy of further analysis. First, there are neither metallic nor (in the propelling pencil sense) moving parts. Neither is it, of course, a propelling pencil in which the lead is pushed forward by a rod moved forward in its turn by a screw motion. Simplicity of manufacture is in its essence here, for not only is the whole structure, with the exception of the lead, of moulded plastic, but it is built up on unit design.



The invention comprises a plurality of hollow conical members each having a hole at its apex, such members being adapted to be screwed together in nested relationship to form a pencil body with an axial passage for the lead.

As the lead becomes used, so the top cone is removed to expose more lead and screwed into the bottom. One cone is stopped to abut against the end of the lead. Obviously two leads of different colours can be used and the pencil can be employed in principle for cosmetics or medicaments.

May I offer my congratulations to Mr. Jeffreys for what I consider a brilliant idea which I hope will prove successful even in these difficult times. I might add that Mr. Jeffreys has himself moulded the first few specimens from red coloured phenol-formaldehyde powder.

Luminous Dog Collars

Here's a photograph of my perfectly black Scottie taken during a black-out. Normally he's almost invisible, on even decent nights, so I've made him a collar of tubular Polythene (the new flexible plastic made by I.C.I., Ltd.) and have coated the inside of the tube with luminous paint. I don't lose him now, although I'm afraid several people have had hysterics

on seeing this ghostly circle of pale green light moving silently a foot above the ground during the recent pitch-black nights. Since Polythene is also made in ribbon form I'm thinking of giving him a rear light, too.

Gas-mask Containers

One of the most obvious of suggestions since gas-masks were doled out to the public was the provision of a plastic container. The replacement of the unsatisfactory cardboard box, admittedly a stop-gap, is long overdue, especially as we seem all set for a three-year contract with our friends the enemy. The entrance of the water-proof jacket, making two cases for each mask, seems illogical. Precision Plastics, Ltd., of Birmingham, have now produced the moulded variety, of which more on another page in this issue.

C

1

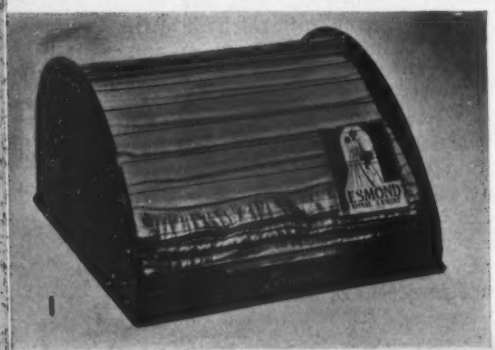
Roll-top showcases are now becoming fairly popular in America, and this one has a cellulose acetate top which permits full visibility of contents and is light and compact to handle.

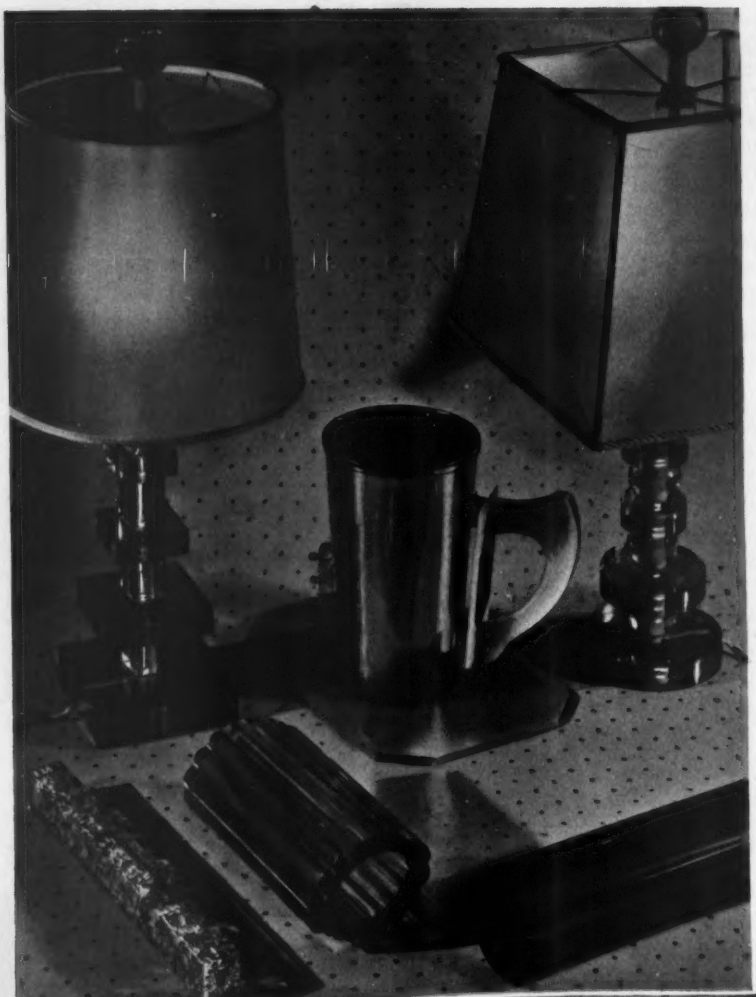
2

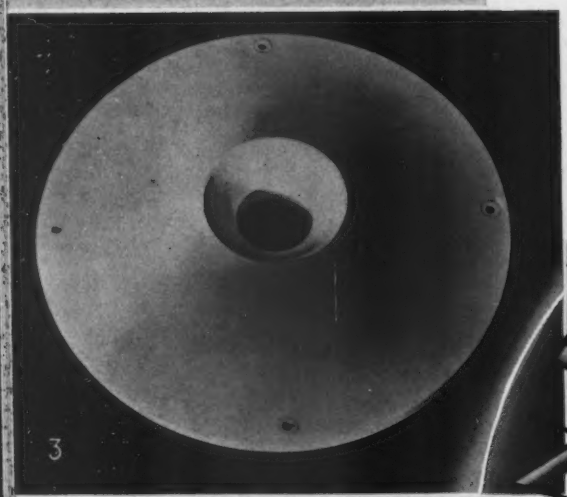
Various examples of Catalin articles which show up to good advantage the glass-clear clarity of the material. In the immediate foreground are two tubes and a rod ready for fabricating.

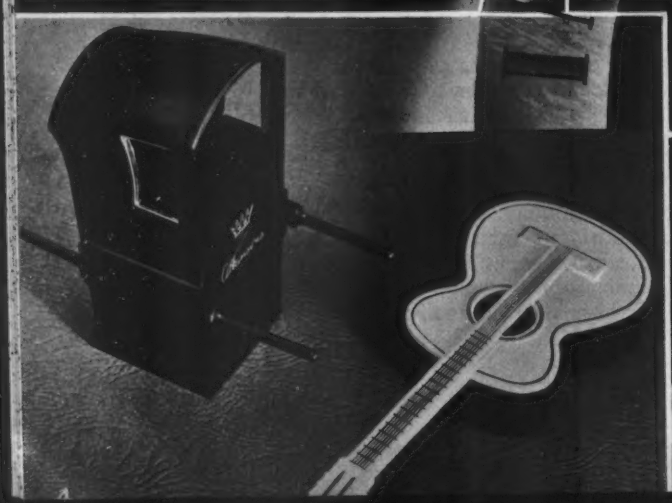
3

This light reflector is moulded of white Scarab manufactured by British Industrial Plastics, Ltd., and moulded by Crystalate, Ltd., Golden Green, Tonbridge, Kent.









4

This cleverly moulded guitar made by Crystalate, Ltd., Golden Green, Tonbridge, Kent, is really a container for perfume. The phial of perfume fits into the body of the instrument, the face of which is detachable.

Crystalate, Ltd., were also responsible for the moulding of the miniature sedan chair, which is an exceedingly neat piece of work. The door, bearing the name of Atkinson, opens downwards and the bottle of perfume is placed in the passenger's position in the sedan chair. The supports are of cellulose acetate, injection moulded.

5

These whistles, or perhaps flutes would be the more correct term, are injection moulded of cellulose acetate material known as Tenite, made by Eastman Kodak of U.S.A. We understand that these musical instruments enjoy a good sale in the States, where there is no lack of youthful and enthusiastic crooners and their accompanists.

6

At the Ford exhibit at the New York World Fair these very efficient robots are kept continually busy demonstrating stages in the manufacture of safety glass. Personally, we consider this diorama an excellent medium of publicity, and this view is shared by many business men who have visited the Fair. Plastics do seem to have done a good job of work.

7

Shaving soap certainly looks a little more attractive in this very sporty container moulded by Crystalate, Ltd. The imitation Japanese lacquered box is also moulded by the same concern.

8

The main point of interest about this exhibit at the New York World Fair is that the miniature flowers, horns of the cows and other small accessories are carved of Lucite, the well-known methyl methacrylate resin manufactured by Du Pont.

9

War or peace, women will always use cosmetics, and we imagine that purchases of lipsticks and other aids to beauty are not likely to slump during the present trouble. The case illustrated is made by Universal Metal Products, Ltd., from cellulose acetate and the tool made so that any engraving can be placed on the base or lid. There is no doubt that cellulose acetate is the ideal material for producing such items as lipstick holders. It enables bright colours to be used which are absolutely permanent under all conditions of use.

10

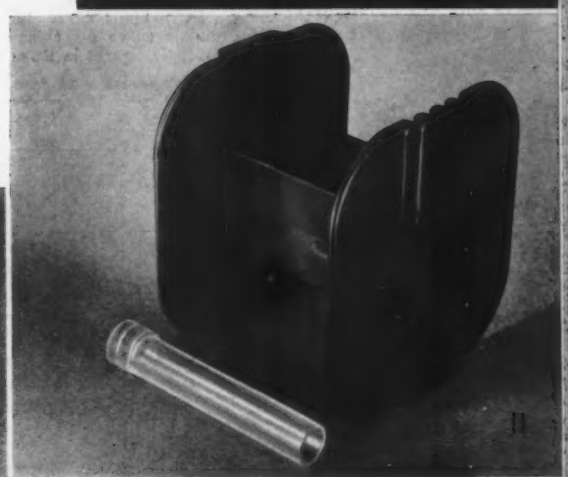
Utility is the main requirement of handles fitted to these domestic utensils and Catalin fulfils all practical requirements. An important sales point is that handles made of Catalin are available in a great variety of colours, either plain or delicately veined or mottled.

11

Bobbins such as the one illustrated are now in great demand in the electrical industries. This particular one was moulded of phenol formaldehyde material on a side ram press at the works of Crystalate, Ltd., Golden Green, Tonbridge, Kent. In the foreground is a polystrene moulding for the electrical industry.

12

For holding powder, bath salts or any other similar commodity this moulded container should be ideal. It is made in wood-filled and paper-filled material by Universal Metal Products, Ltd., Langley Road, Pendleton, Salford, Lancs.



PLASTIC BEARINGS for Modern Machinery

By **Dr. Paul Grodzinski,** Consulting Engineer

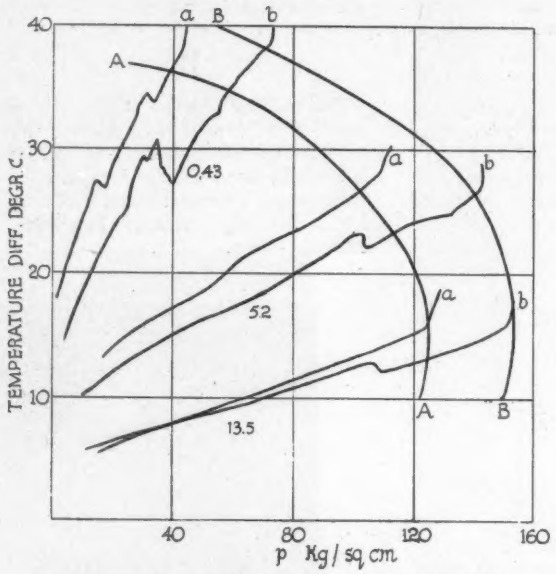


Fig. 1.—Influence of wall thickness and oil supply on the loadability of plastic bearings according to Strohauer. (a) Bearing of 6 mm. wall thickness. (b) Bearing of 3 mm. wall thickness. (AA) Limit curve for thick walled bearings. (BB) Limit curve for thin walled bearings. Above oil supply figures in litres per hr.

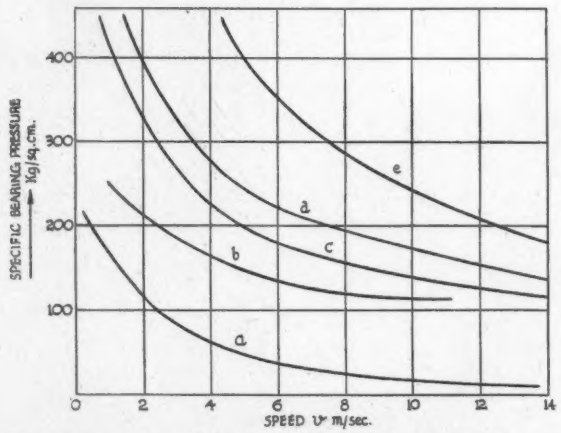


Fig. 3.—p and v.—Curves according to the investigations of Lehr. (a) Cellulose fabric, chipped, with 50% phenol, moulded 5 mins. at 160 deg. C. (b) Cotton fabric, moulded, with 50% phenol, 5 mins. at 160 deg. C. (c) Cotton fabric finely chipped with 45% phenol, moulded 20 mins. at 165 deg. C, finished moulded 8 hours at 125 deg. C. (d) Cotton fabric with 16% cellulose wool, with 55% cresol, wound and finished moulded for 60 mins. at 165 deg. C. (e) Cotton fabric with 50% cresol, wound and finished pressed and hardened. Oil supply, 60 litres per hr.; oil entrance temperature, 25 deg. C.; bearing clearance, 0.24 mm.; length/diam. = 0.66, diam. = 60 mm.

THE introduction of a new kind of bearing material in modern industry must necessarily be a very intricate one, in view of its fundamental importance as an integral part of the machine; indeed, the whole function of the machine depends on the trouble-free operation of bearings. Failure of the bearings causes an immediate dislocation of plant, and this, of course, can be very serious in case of large mechanical installations, such as baggers, cranes, printing machinery, etc. A breakdown of one hour may cause a loss in production, which cannot easily be recovered. In view of this it is not difficult to understand why manufacturers and users of such machines should be hesitant in making changes and, perhaps, inclined to be over-cautious in the selection of bearing materials. The general tendency

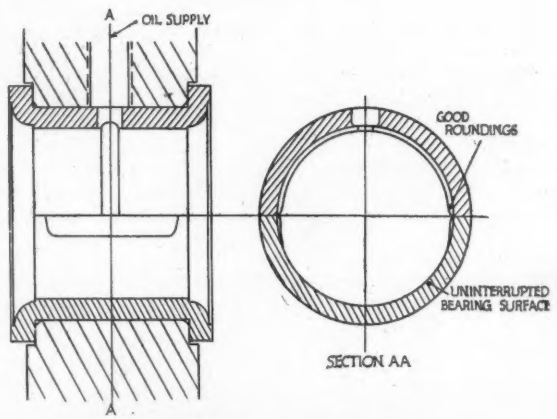


Fig. 2.—Design of a plastic bearing according to the recommended practice of VDI, January, 1939. The Good roundings should be specially observed.

seems to be to play for safety by using relatively expensive metals of known performance, in particular those of high tin content, which have been proved to give a reasonably good performance on long runs.

During the last few years great efforts have been made in practically all industrial countries to discover new and improved bearing materials for use in high-speed machines and where heavy loads are common. Although not all these experiments have proved successful, the research work and practical tests have made out a very strong case for certain of these new materials. The main point in the evolution of a suitable bearing material is that bearing failure should only cause a period of slow running and not be responsible for an absolute standstill, as total breakdown of the machine causes severe dislocation of production. Some of the recognized and common metallic bearings have an injurious effect on the shaft material, and sometimes

when bearing shells are entirely broken down, owing to wedging action, machine bodies and shafts are completely destroyed. Taking this fully into consideration, engineers are anxious to find bearing materials with a reserve of running capacity in emergency. This means, of course, that bearing and shafts must, under the most severe conditions of service, be able to rotate if only at a reduced speed and under a condition of greater relative clearance. This was hitherto a property of metal alloys of low melting points containing higher per-

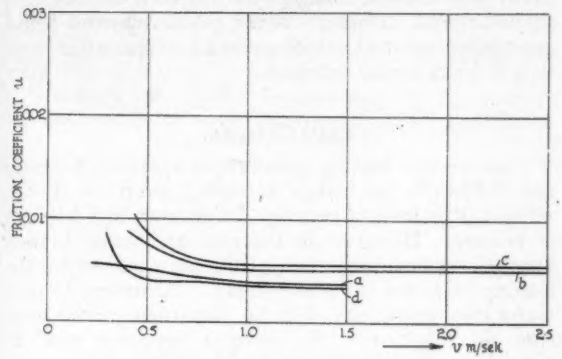


Fig. 4.—Relation between friction co-efficient and speed on bearings for rolling stock according to Maekelt. Specific bearing pressure p = 50 kg/sq. cm. (715 lb./sq. in.). (a) Plastic bearing, cotton fabric with 20% cellulose wool, 65% cresol. (b) Plastic bearing with asbestos fabric, about 60% cresol. (c) Babbitt metal. (d) Aluminium.

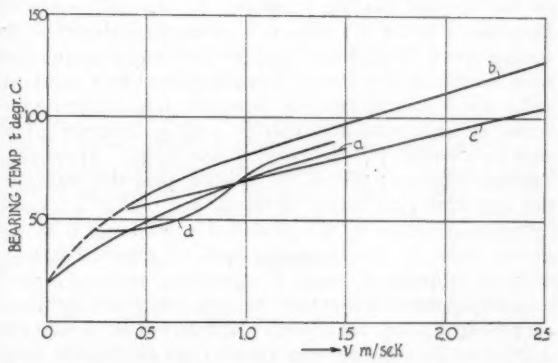


Fig. 5.—Relation between bearing temperature and speed on bearings for rolling stock according to Maekelt. Constants same as given in Fig. 4.

centages of tin and lead; however, some of the new alloys of higher bearing capacity are harder and do not possess this very important property.

Plastic bearings have the ability to withstand the action of heat and do not score or injure the shaft. Indeed, in normal service the shaft service is even improved by the wearing action of laminated or moulded bearings, which are now often used for lapping spindles, etc. Plastic bearings permit a longer running period when the supply of lubricating fluid is stopped than is the case with metallic bearings, as a considerable proportion of oil is held by the bearing brasses. Foreign matters, such as dirt and sand, which usually cause a burning of the material, do not affect the running quality of a synthetic bearing, as this is able to imbed foreign matters in its surface.

The question may well be asked whether plastics can be considered a serious competitor of metal for bearings, bushes, etc. Non-metallic gears, made of practically the same materials as are now being used for bearings, have proved very successful during the past 20 years; the dimensions of these gears remain usually the same as that of metallic gears. This means that, in spite of the different properties, the main permissible stresses can be considered as the same. A main factor for the successful operation of a gear drive is the wear of the gear flanks operating under very hard conditions, compared with those existing in a normal bearing. Another consideration is that in high-speed bearings the bearing shell and shaft surfaces are separated by an intermediate film of oil, and that, therefore, the physical properties of both shaft material and bearing are not of themselves of such great importance, always provided that the surfaces are very smooth and separated by a fluid film. This condition is, however, not present when the machine is starting and running at relatively low speeds. Scientifically the conditions in these cases are known under the designation of boundary friction, and besides

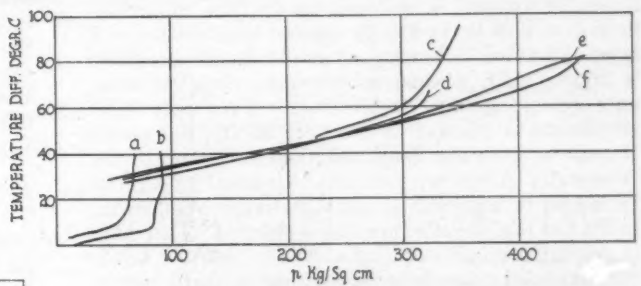


Fig. 6.—Plastic bearings compared with metal bearings according to Strohauer. (a) Coarse textile fabric 50% cresol, 6 mm. wall thickness. (b) Fine textile fabric 50% cresol, 6 mm. wall thickness. (c) Babbitt metal, 80% tin. (d) Zinc. (e) Aluminium-magnesium alloy L22. (f) Copper lead bronze. Length/diam. = 0.5, diam. = 40 mm., n = 1,000 rev. p. min.; v = 2.09 m/s. Oil supply for plastic bearings a and b: 13.5 litres per hr. Oil supply for metal bearings c to f: 0.43 litres per hr.

the characteristic property of the lubricating oil, the special properties of the bearing material are of importance. The influence of the bearing material in the range of fluid friction is not yet fully discovered; the influence may be very slow as so many different materials are suitable in this respect; however, the limit with regard to speed and specific pressure is always imposed by the physical properties of the bearing materials.

In the general search for improved bearing materials it is fundamentally a sound proposition to utilize plastics. This is amply supported by the fact that plastic bearings have proved a great success for rolling mills. It must, however, be admitted that here rather extreme conditions exist and that, in similar circumstances, wooden bearings had already proved quite satisfactory, a condition which never existed in modern high-speed machinery.

A number of general investigations, both scientific and practical, have been carried out to show the value of plastic bearings under varying conditions of service, but there is still a dearth of reliable information. The

factors of paramount importance are the thickness of bearing shell, bearing clearances, length of bearing, supply of the lubricating fluid, and last, but not least, the specific bearing pressures. The wall thickness should be 5 to 10 per cent. of the shaft diameter; this corresponds to usual values of metallic bushes, so that a mutual replacement seems to be possible without main alterations. For larger diameters the smaller wall thickness, according to the above given values, can be recommended. Sometimes it is proposed to use for plastic bearings smaller wall thicknesses with regard to their lower heat conductivity; however, this argument is not always correct, as practically all the heat generated in the bearing must be deducted by the lubricating fluid, and the results of tests showing an increased loadability for thin-walled bearings (Fig. 1) are not absolutely convincing. However, more can be expected from bearings with steel or aluminium backings, in which cases only relatively thin-walled plastic coverings are necessary. Unfortunately until now no general data is available on these bearings.

Length of Bearing.

The length of bearing is of great importance, but hitherto no general recommendation has been given for bearings moulded from chipped textile materials. If laminated material is used and the direction of laminations is vertical to the axis, a value of length/diam. = 1 is recommended, as bearings of smaller lengths are liable to become split, whereas on longer bearings the resistance against splitting is increased. Eventually axial stresses can be taken off by means of metallic side plates. It may be generally remarked that, according to the present-day experience, bearings of reduced lengths can be loaded to a greater extent than longer ones, owing to the fact that the edge pressure is relieved. Therefore, in general, a relation of length/diam. = 0.7 to 1 can be recommended; especially on high-speed shafts narrow bearings should be employed (Fig. 2).

Diameter of Shaft.

In the case where the shaft diameter is given the selection of the bearing lengths already determines the specific bearing pressure. Usually, however, the designer has a free choice of both shaft diameter and bearing length, therefore the problem of the specific bearing pressure will be dealt with in a later paragraph.

The clearance of bearings is a special problem, and until now it does not seem to be completely solved. Special conditions are caused by the high heat expansion, the swelling and shrinking and, further, in the difficulties of exact machining of these materials. The bearing clearance is usually 50 to 100 per cent. greater than on metal bearings; recommended values are 0.25 to 0.4 per cent. of the shaft diameter; in any case the smallest clearance should be somewhat greater than usual on a metallic bearing. In the case of the plastic material the hole should have the greatest manufacturing tolerance. Usual tolerances for shafts and bearings are given in Table 1. In the case of bushes rotating with the shafts, other tolerances must be taken into consideration.

The new assembled bearings should have the maximum possible clearance; owing to the influence of temperature during service and also the lubricant, the clearances are soon reduced to usual values.

The shaft must be absolutely cylindrical and should have a hard and smooth surface. The shaft needs to be hardened, ground and polished to reduce the friction

TABLE I.—Maximum and Minimum Bearing Clearances

Diameter in.	Clearance in. Minimum	Clearance in. Maximum
¼ to ½	0.002	0.0044
½ to ¾	0.0025	0.0047
¾ to 1½	0.0028	0.0059
1½ to 2	0.0032	0.0071
2 to 3⅛	0.004	0.008
3⅛ to 4½	0.0048	0.0100
4½ to 7⅛	0.0055	0.011

in the bearing as much as possible. Soft and rough shafts would cause a high wear on both bearing and shaft material. During use the plastic material has a good influence on the shaft material, so that after some time it looks highly polished.

Load Capacity.

The specific bearing pressure in enclosed bearings and bushes is calculated according to $p = P/l.d$, wherein P is load of bearing, d diameter, and l length of bearing. However, in the case of bearing brasses only the vertical projection of the arc enclosed by the bearing brass has to be introduced. According to tests under ideal conditions (Fig. 3), in particular with pressure oil lubrication, the specific pressures can be extended as high as 450 kg./sq. cm. (6,200 lb./sq. in.); however, tests under conditions corresponding more to those in actual service (Figs. 4 to 6) showed only a load capacity of 25 to 50 kg./sq. cm. (350 to 700 lb./sq. in.). But the majority of values published in literature show that the load capacity of plastic bearings is limited between 50 to 100 kg./sq. cm. (700 to 1,400 lb./sq. in.).

Bearing Pressure.

There exists a distinct influence of the rotating speed on the specific bearing pressure. In the old technical literature a factor p.v with $v = d.\pi n$ circumferential or sliding speed of diameter d of the bearing, n = revolutions of the shaft per min. was considered as a constant value for a distinct bearing material; this factor represents, in any case, the specific cooling capacity of a bearing divided by the friction coefficient. However, modern engineers are of the opinion that this value is not constant and that a formula $p.v^k$ or $p^k.v$ would correspond better to the practical conditions, k being greater than 1. For instance, tests on plastic bearings with oil lubrication, made by Graebing, showed a permissible speed of 1.8 m/sec. for a specific bearing pressure of 40 kg./sq. cm. (p.v. = 72) and 3.18 m/sec. for a load of 30 kg./sq. cm. (p.v = 95.4). But it is recognized that in both conditions a formula of $p.v^2$ or $p^2.v$ would yield the same result. When a value of k = 2 results, this does not mean that for other kinds of materials or under other conditions the same value may be present; for instance, the tests of Lehr (Fig. 3) seem to indicate that k is below 1, about 1/2 and 3/4 for the best plastic bearing materials e and d.

Indications show that up to values of p.v = 100 m.k.g./cm.^{2} sec., namely low pressure, the usual ring lubrication can be applied, above these pressure oil lubrication has to be introduced. Heidedroek, who carried out a number of investigations with these bearings, made the remark that the load capacity of a bearing is inversely proportional to the square of the bearing clearance. As one is compelled to use a greater bearing clearance on plastic bearings, this fact shows that the bearing capacity of these bearings is more limited than those of metal bearings.

For lower loads the usual wick oiler may be suitable, but on all higher loads pressure oil lubrication should be provided as here, more than in metallic bearings, the purpose of the lubricant is to carry the heat away. It may be of interest to state that the load capacity increases considerably with the amount of oil supplied, as shown by tests carried out by Strohauer. With an oil supply of 0.43 l/h the specific bearing pressure could only be increased up to 25 kg./sq. cm.; when the supply of lubricating oil was increased to 13.5 l/h, according to the composition of bearing, the specific pressure could be increased to 50 to 85 kg./sq. cm. Tests made by Lehr showed that, under an oil supply of 60 l/h, the specific loads could be increased up to 450 kg./sq. cm. (Fig. 3).

Grease can be applied for bearings with low circumferential speed or when the bearing is not continually used. These bearings are usually provided with grease containers; however, for higher loaded bearings grease blocks should be incorporated in the bearing.

Lubrication

Good prospects are opened for lubrication by means of water and water-oil-emulsions for high loaded bearings. Hitherto, only in the case of roll mills and bearings in marine work, water lubrication has been applied. If, however, other machines are designed in such a way that a water lubrication could not cause corrosion of vital parts of the machine, then this inexpensive and highly effective kind of lubrication should be taken into consideration. In the case of lubricating oil, at a temperature of about 100 degrees C. the oil develops steam and smoke, and at temperatures of 120 to 130 degrees C. most of the usual lubricating oils lose their lubricating capacity; metal bearing alloys tend to melt under severe conditions of service, and plastic bearings to carbonize. In the case of high temperatures, water is converted into steam, and this involves a considerable evolution of heat, which needs to be taken away from the bearing surface; this means, of course, that the bearing must be properly cooled.

The applied lubricant should be absolutely free of acids and should cause a very small swelling of the plastic bearing. This tendency to swell the material is greater in the case of thin fluid oils than in oils of high viscosity. Water and emulsions cause a somewhat greater swelling, so that in this case a greater clearance has to be allowed.

From the great number of plastic materials now in use for distinct purposes, only a few are suitable for plastic bearings. In an important investigation carried out in Germany to find a suitable material for bearing brasses on rolling stock for field railways and lorries, out of 20 different plastic bearing materials only two showed good results and comparable properties with metal bearings; the one was laminated fabric with 20 per cent. cellulose material, and the other asbestos fabric with cresol as binding material; in the first case 65 per cent. and in the latter about 60 per cent. The bearings were made from a wound tube, hardened for 8 to 12 hours without pressing; the bearing surfaces were ground. For usual conditions a recommended practice of the VDI recommends two materials, T_2 and T_3, i.e., phenol resins with textile fibre; in the first case a chipped material and in the second a laminated textile are used. In special cases, when the bearing should be machined out of blocks or tubes, laminated fabrics of the class G (coarse) and class F (fine) are to be used. Table I contains a survey on the different manufacturing possibilities when using the above-mentioned materials according to the recommendations.

These are recommendations for materials and methods of manufacture of plastic bearings based on current Continental practice where a great deal of research work has been carried out. T_2 and T_3 are phenolic resins with textile fibre; the first being a chipped material and the second a laminated textile is used. G is a coarse fibre laminated fabric and F a fine material.

TABLE 2.

DESIGN OF BEARING	MATERIAL	APPLICATION BEARING BRASSES BUSHES	REMARKS
MOULDED BEARINGS FINISHED IN MOULDS RESPECTIVELY SLIGHTLY MACHINED	T_2	Entirely Moulded	FOR HIGHER NUMBERS OF BEARINGS UNDER USUAL CONDITIONS
	T_3	Entirely Moulded	FOR HIGHER NUMBERS OF BEARINGS UNDER HIGH DUTY CONDITIONS
BEARINGS MACHINED FROM TUBES. THE TUBES ARE PRESSED IN MOULDS AFTER WINDING	G AND F		FOR SMALL AND LARGE NUMBERS OF BEARINGS UNDER HIGH DUTY CONDITIONS
	T_2		DTO. UNDER USUAL CONDITIONS
BEARINGS MACHINED OUT OF BLOCKS BARS AND PLATES	G AND F		MAINLY FOR SINGLE PIECE PRODUCTION AND FOR HEAVY DUTY CONDITIONS IN PARTICULAR FOR BRASSES
	T_2		DTO UNDER USUAL CONDITIONS

Operating Conditions

To provide favourable operating conditions for plastic bearings, the following facts should be observed in machines hitherto equipped with metallic bearing shells:—Short bearing distance, stiff shafts of low deflection, alignment of hole in bearing blocks with the centre line of shaft (as these bearings are very sensitive against edge pressure). Bushes should be pressed-in in the holes; in these cases no further means of securing are necessary. On the side which is pressed-in, the bush should be provided with a chamfer. The press fit allowances have to be made four times greater than usual to equalize the influence of the lower modulus of elasticity of these materials. By means of a tight fit any loosening

or shrinking of the bearing bush is avoided, and simultaneously a better deduction of the friction heat is provided.

Plastic bearings, in contrast to metallic bearings, are very sensitive towards an increase of load, particularly when the bearings are new. Several investigations have shown that the bearings were "blocked" when the load on the bearing was increased. An increase of only 2 to 3 kg./sq. cm. (27.5 to 41 lb./sq. in.) is sufficient to cause these conditions, which can be recognized by a rapid increase of friction and temperature, whereby the friction torque is sometimes increased to 30 times its original, this resulting in immediate seizure of the bearing, although neither journal nor shaft suffer damage. A short run restores normality. Strohauer is of the opinion that this special condition, observed only on plastic bearings, is caused by a local pressing out of resin contents which has not yet hardened or polymerized sufficiently. When this condition has disappeared one can observe some bright spots on the bearing surface. This opinion is further supported by the fact that afterwards an increase in bearing clearance and a reduction of the oil pressure can be observed. However, further investigations seem to be necessary to give a full understanding of the blocking conditions. After a reasonable length of service, especially when the load is alternatively increased or reduced, the plastic bearings lose their sensitiveness against increased loads. It is, therefore, recommended to increase at first the load from part load to full load at low speed, and then to apply the same process at higher speeds. The running-in period requires usually several days; it can, however, be reduced by a good machining of the bearing surfaces. The highly polished surfaces of bearings after the run-in period show excellent friction characteristics.

On bearings for rolling mills lower friction coefficients can be observed and, therefore, the friction losses considerably reduced. Investigations of machine bearings have shown that no friction characteristics of the same kind as in the case of metal bearings can be expected. The behaviour of the bearings in the case of boundary friction has hitherto not been sufficiently clear.

The wear of new bearings is considerably more than those which have been in use some little time. In order to ensure that new bearings do not wear excessively, it is recommended to place them in an oil bath of 90 to 100 degrees C. for about 24 hours, so that they will soak up plenty of oil. In this way not only will good running conditions be secured when the oil supply is known to be irregular, but a further swelling or shrinking of the bearing material itself be prevented.

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Neoprene in the Printing Industry

NEOPRENE is to-day finding important applications in the printing industry for the manufacture of rollers, blankets, stereo compounds, etc., with a high resistance to oils and increased wearing properties. In number six of "Neoprene News" there is a very useful and practical article on this subject, which is based on a lecture given some time ago by Mr. Robert B. Clarke in Stationers' Hall, London, E.C.

It is pointed out that whilst neoprene has the same flexibility, resilience and resistance to abrasion as natural rubber, it is less susceptible to oxidation and ageing and is more resistant to oil (both vegetable and mineral) and solvents.

The natural ageing of neoprene has not yet reached finality. Under the most rapid ageing test used by the rubber technologist—viz., the Bierer Davis Bomb, in which the sample is exposed at 70 deg. C. to oxygen at a pressure of 300 lb. per square in.—neoprene is still suitable for use after 100 days. A rubber compound containing an antioxidant is considered to be first class if it remains serviceable after five days in the bomb.

In the du Pont belt-flexing test, used to evaluate resistance to flex cracking, rubber withstands only 190 hours' flexing, while neoprene can be flexed for 700 hours without signs of cracking.

The resistance of neoprene to oils or solvents is an important property of this new material. As there are no accepted standards for the determination of oil resistance, some standard must be acknowledged before this property can be discussed. It will be agreed that the primary shortcomings of natural rubber compositions is not that they swell, but that after exposure to oils they lose a great deal of their initial strength, elasticity and toughness. The definition of oil resistance can, therefore, be stated as the degree to which the product retains its original characteristics on exposure to the oils or solvents that may be encountered in service under the maximum probable service temperatures. The different oils vary considerably in their action upon natural rubber or neoprene and often entail a thorough investigation before a suitable compound can be evolved to meet the specific requirements of the user.

Neoprene has a marked resistance to the deteriorating effects of printing inks. An instance of this is given by the fact that four years ago a neoprene roller was installed on a newspaper printing machine to replace the standard type of rubber roller. This neoprene is still in excellent condition. Examination of commercial and newspaper rollers made from neoprene shows that very little grinding is required for refinishing, because inks and washing solutions do not penetrate deeply. The total service life of neoprene rollers and plates, as well as the service the rollers will give before re-grinding is required, cannot be stated definitely, since both periods are dependent upon the service conditions and the type of composition used. A great deal depends on the ability of the roller manufacturer to supply a composition best adapted to the use for which it is intended. In view of the many possible ways of compounding neoprene, rollers are available for every purpose and are suitable for lithographic, offset and ordinary printing.

Neoprene has been found satisfactory as an engraver's rubber: it is stated that the dies cut clean and hold their edges, for, while being sufficiently resilient, neoprene is tough and not subject to crumbling or nicking under ordinary printing conditions. The factory manipulation of neoprene, as supplied to the printing industry for the purpose of stereos, is comparable with that of rubber for the same purpose; suitable compounds to give hard or soft products can be obtained from the normal suppliers of rubber sheeting, and full information on this and other points can be obtained from I.C.I.

Inquiries and Answers

Handbag Handles

Leicester.

The Editor, *Plastics*.

Dear Sir,—We should be glad to know if you could put us in touch with one of the manufacturers of plastics. We are interested in handles suitable for ladies' handbags. DRYAD, LTD.

[EDITOR'S NOTE.—A great many handles are being produced, either from castings of synthetic resin or by the moulding of them. The inquirer should get into touch with Erinoid, Ltd., Catalin, Ltd., and F. A. Hughes, Ltd., for cast phenolic resins, and with Imperial Chemical Industries, Ltd., for information on Perspex, which would be very suitable. Any moulding concern would probably be able to advise on mouldings, although large quantities of exactly similar designs enter the problem.

Cellulose acetate and casein would produce very beautiful and strong handles. Erinoid, Ltd., and B.X. Plastics, Ltd., should be approached regarding these.

Addresses are given in the Directory in the early pages of this issue.]

Wheels for Taps

Doncaster.

The Editor, *Plastics*.

Dear Sir,—We should be pleased if you could advise us where we can purchase moulded wheels for stop taps. These would require to be about 2 ins. diameter with a metal insert for ¼-in. square spindle marked "Open" and "Shut" and in red and black. We require about 250 at the moment and never require these in quantities big enough to justify the making of dies for our purpose alone. We feel sure there must be certain firms in your trade which make these wheels and have dies which would be quite suitable for our requirements. Any advice you could give us would be appreciated.

WOODHOUSE AND CO., LTD.

[EDITOR'S NOTE.—In view of the small number of taps required, this seems obviously a job for either cast resins of the phenol or acrylic type in which a simple and relatively cheap mould is used to cast the rough shape in rod form or alternatively, if the tap is not in continuous contact with water or steam, for casein. In both cases the rough shape is tooled by hand or machine to the finished form. Even so, this may prove expensive unless the 250 order is repeated at intervals. The only alternative is that some concerns already make such taps by moulding and hold the mould in stock. Inquiries should be made of Evered and Co., Ltd., Roanoid, Ltd., and others who specialize in such furniture. For cast phenols apply to Catalin, Ltd., Erinoid, Ltd., or F. A. Hughes and Co., Ltd. For cast acrylic resins (that is Perspex) to I.C.I. (Plastics), Ltd. For casein mouldings to BX Plastics, Ltd., or Erinoid, Ltd.]

Accurate Moulding

Slough Trading Estate.

The Editor, *Plastics*.

Dear Sir,—We read with interest the article in the August issue of *Plastics*, under the title of "Moulding to '3 thou' Limits."

We enclose an insulation ring, of which we have recently completed the moulding of a long run, ex a four-impression mould. These rings are accurate to a "2 thou" limit, that is, .001 up or down.

The fact that not one of these mouldings was rejected speaks well for the accuracy of our plant.

As this moulding was carried out for a Government Department we regret that we must ask you not to publish a photograph of it.

BRITISH ARTID PLASTICS, LTD.

GENERAL.

The following inquiries, which needed only names and addresses of manufacturers for answer, have been received:—

B. H. Ries, Ltd., 19-21, Hatton Garden, London, E.C.1. Makers of bottle caps.

William Pearson, Ltd., 172, Buckingham Palace Road, London, S.W.1. Manufacturers of "Polex."

Tozer, Kemsley and Milbourne, 84, Fenchurch Street, London, E.C.3. Name of supplier of the "Ray Dyot" ideal picnic cocktail outfit.

Wondegrip Products, Ltd., Great West Road, Brentford, Middlesex. Manufacturers of Bakelite bonded plywood.

(Those interested should write to the respective addresses.)

The German People's Car

Some time ago we wrote to Mr. Edwin Heinze, the well-known German motor engineer, for information regarding plastics in the proposed German People's Car. We have only just received his reply, for presumably it was held up by the Censor.

Poessneck/Thur.
August 30, 1939.

The Editor, *Plastics*.

Dear Sir,—Your letter of August 11 arrived while I was away from home on holidays, which is the cause of the delay in my response.

I shall certainly be very pleased to write for you the desired article, but I am very much afraid that I will not be able to supply it so quickly as you appear to require it. It is a pity I did not know earlier your requirements, because a few weeks ago I had a trip on the People's Car, but I did not think of looking over it for the number of points on which plastics are employed. I have immediately written the factory for details but fear these will take some time before I receive them. As soon as things are a little more settled again I intend paying the works a visit and to have a good look at the parts of the car. When this can be it is impossible to say. If I receive the material in good time I would, of course, be able to supply the article sooner. I fear that even in this case several weeks will elapse. Please let me know whether, under these conditions, you still want the report.

Yours very truly,
EDWIN P. A. HEINZE.

We fear his report must be held over and we shall wait until once again sanity rules the world and until scientists and industrialists can set the wheels of normal life moving. In the meantime we presume that the German *Volkswagen*, like its British opposite number, will not carry much *volk*.

WORLD'S INDUSTRIAL

TEXTILES

Rot-proofing textile material can be successfully carried out by chemical treatment, such as impregnation with copper naphthenate solution, acetylation and Bakelite varnish. Mr. S. G. Barker read an important paper on this subject before a meeting of the Food Group, Microbiological Panel, December 14, 1938. Protection can be assured by one of three methods. First, the addition of suitable antiseptics to the fabric. Second, the treatment of the fabric material, e.g., by acetylation, i.e., similar treatment such as would be used to produce acetate rayon. Third. the rendering of the fabric or fibres water repellent by some specific method. It is probable that the waterproofing function is largely responsible for many creosotic, tarry, rubber and bitumen treatments. **Rubber-lined** iron vats will, it is confidently expected, be in great demand owing to the restricted supply of stainless steel and porcelain vessels. They are particularly useful for long runs in one colour and have important advantages over stainless steel and porcelain. The former has a noticeable catalytic effect on certain bleaches and possesses a relatively high capacity for heat conduction. Porcelain has the disadvantage of being very sensible to temperature influences, rendering it liable to crack. It is also relatively weak mechanically. Moreover, dye is likely to remain in the joints, although modern practice has done much to eliminate all these defects. The fact of the dyeing of the cement in the joints must be accepted, but should be correctly assessed. Thousands of porcelain dye vessels are in use without complaint. The joints hold dyestuff residues, but on changing a colour it is possible to clean off surface residue with a wire brush. **Synthetic resins** used to an increasing extent in the processing of various textiles. Dr. Hans Gerber, in Melliand, 6, 287, 1939, describes experiments using an aqueous solution of mixed polymerisation products of polyacrylic acid as a thickener for printing colours. The solution comprised 15 per cent. dry substance, consisting of a mixed polymerisation product from 65 per cent. polyacrylic acid nitrile and 35 per cent. sodium salt of polyacrylic acid, adjusted at the requisite pH value of ammonia. It was found that the thickening could be used wherever a neutral or alkaline medium was present, i.e., chiefly with direct and vat dyes. It was suitable for use with at least 80 per cent. of the dyes used in calico printing. Comparative prints were made with starch/tragacanth thickening (40/100/1,100) under the same conditions and with the same printing colours as with the mixed polymerisation products. It was found that the depth of shade was identical in both cases when using Rapidogen dyes and Indigosols, but that Indanthrene dyes had to be steamed rather longer than usual to fix the colour. It has been shown that it is possible to prepare thickenings of purely synthetic origin on the basis of the so-called coal-lime product. These meet the requirements of working practice and have the advantage that they are ready for use at once without having to be boiled or broken down. They are also stable for any length of time, even in the form of printing pastes.

ELECTRICAL

Moulded parts simplify construction is the experience of manufacturers who use plastics in preference to metal, wood and ceramic materials. *The Electrician*, September 8, 1939, quotes as an example the modern moulded telephone set which consists almost entirely of mouldings; the assembly is much simpler than if different materials of construction were used. Many of the metal parts, wires, etc., are included in the mouldings and are already in the correct positions before assembly proper begins. A circuit breaker which has recently been placed on the market provides another example of this. The article in question consists of four main mouldings: (a) a moulded base, containing inserts all moulded in position, (b) a moulded cover, (c) a moulded locking bar which has to be pressed down before the switch can be operated, and (d) the lever for the switch itself which is moulded. For assembly, the switch and locking bar are placed in position in the cover from the inside, the cover is placed in position over the base, and two nuts are screwed on to the two bolts moulded into the base which pass through holes in the cover. The natural consequence of this trend of development has been the design of very intricate mouldings, which in turn has necessitated the production of complicated moulds. Owing to armament work, there is at present sometimes delay in obtaining delivery of these complicated moulds, but, on the other hand, this may be for good in the long run. The demands of armament work for precision tools have resulted in the training of skilled operatives, who will be available for the plastics industry when armament work is finished. Examples of these intricate mouldings are to be found in electric drill cases, electricity meter cases, and electric terminal blocks. Electric drill cases have been produced in the form of two separate mouldings which, placed together, serve as handle and case for the electric motor. The inside of these two mouldings is fitted with various bars, holes, screws, etc., to enable all the internal mechanism to be held in position both securely and simply. Recently, a cinema motor case has been moulded in plastic material. This housing is in the form of a sort of cage and the whole is produced in one operation and in one part. It provides perfect safety and combines this with an excellent finish and appearance. This is just another example of what can be done with plastic materials for intricate articles.

AIRCRAFT

Bakelite for propeller shaft liners has important advantages over lignum vitæ. According to "Bakelite Progress," the house organ of Bakelite, Ltd., propeller shaft liners for passenger and merchant vessels when made from lignum vitæ have a life of approximately two years, which, in view of the arduous conditions of service, has, hitherto, been considered to be fairly satisfactory. Observations have recently been made on the life of bearings for this particular application when made from Bakelite laminated material. About a year ago a stern shaft liner of this type was installed, and inspection after this period of service showed that the laminated bush had worn about 1/32 in., and as replacement is normally undertaken at ¼-in. wear, the bush should be good for several more years of life. Another potential application for this grade of Bakelite material in the shipbuilding sphere is considered to be for pin liners on rudder brackets. It is interesting to record that The Bushing Co., Ltd., have for some years now specialized in the production of moulded and fabricated laminated parts for aeronautical construction.

REMPLOYS PLASTICS

MOTORS

Friction lining for brakes and clutches comprises a compressed composition of aluminium, steel or other metal wool, and a binder of artificial or natural resin, caoutchouc and the like, with or without the addition of asbestos fibres and powdered fibres. Method of manufacture protected by B.P. 505,922. **Moulding vehicle doors** covered by recent patent taken out by Auto Union Akt-Ges. The process of manufacture consists in first forming a partially hardened self-supporting shell comprising a thin-walled panel portion and a peripheral rim portion of synthetic-resinous substance containing disintegrated undirectionally arranged fibres, then placing in position reinforcing members of a material saturated with synthetic resin and finally subjecting the assembly to heat and pressure to unite and complete the heat hardening. **Brake shoes** having a layer of glass silk impregnated with synthetic resin patented by General Motors Corporation. Claimed that avoidance of the effects of change of humidity is assured by the layer of fibrous glass and also a lessening of the transfer heat to the shoe.

MISCELLANEOUS

Paper for plastics, discussed by Mr. J. G. Abel, chief chemist of Wiggins Teape and Co. (1919), Ltd., in a lecture before a meeting of the Plastics Group, January 10, 1939, has just been published in *Chemistry and Industry*, August 26, 1939. **Coloured cellulose acetate sheets** now being used by local authorities to darken windows of hospitals and other buildings. According to *The Lancet*, September 2, 1939, samples of Rhodoid have been tested at the Government's building-research station at Watford, and at the Bradford Royal Infirmary. Here the A.R.P. committee fitted one room with lamps covered with pink-tinted Rhodoid shades. A similar tinted pale blue covering to the windows made the pale red light from the lamps completely invisible from outside. The material is fixed permanently to the inside of the windows by means of an easily applied adhesive. When there is no danger from an air raid, windows can be left open in the usual way and so admit ordinary daylight, which practically eliminates the blue tint. At night, with all the lights on and no opaque covering across the windows, not a glimmer can be seen from outside. The windows are quite black, as though boarded in. By day or night, if warning of an air raid is received, all that is necessary in any building equipped in this way is to close the windows and fasten the pink lamp shades. Activities can continue inside uninterrupted. The system should be of particular value for operating theatres where by means of special wiring arrangements illumination can be instantly switched from white to pink as soon as a warning is heard. We understand that a similar system is in operation in parts of St. Thomas's Hospital, where tinted bulbs are used. **Applying lacquer to metal foil** now being carried out with solid neoprene rollers on a metal core. These rollers, which are of hard grade, give more than 50 per cent. longer useful life than the rubber rollers previously employed. Deterioration of the rubber rollers is attributed to ethyl acetate, which, with methylated spirit, forms the solvents in the lacquer. The economic advantage secured by this application of neoprene is very definite. The neoprene rollers, which have been found to give 50 per cent. longer life, cost, individually, only 10 per cent. more than the rubber rollers formerly in use. **Moulding lenses** from synthetic resin described in recent British Patent No. 505,836. Optical lenses and prisms, particularly ophthalmic lenses, are moulded from transparent thermoplastic materials in moulds of glass or quartz. The glass mould may be secured to a metal support and have an interposed gypsum layer. The mould is polished to give the required lens surface and may be heated or the heated material pressed between cold moulds. Vinyl, acrylic polystyrene and cellulosic plastics are mentioned in the patent specification.

New plastic from sugar cane bagasse made by chemists of the United States Department of Agriculture at the Agricultural By-products Laboratory, Ames, Iowa, U.S.A., and reported in *Scientific American*, September, 1939. The chemists estimate that this new compound can be manufactured for less than half the cost of the cheapest synthetic plastic compound now on the market. Moulding compounds may be made from the bagasse by three methods. The first and cheapest is hydrolysis with acid. Counting the cost of bagasse at 33s. 4d. a ton, baled and delivered at the factory, the chemists estimate that a plastic compound can be made by this method, in which the cost of material will be slightly more than a penny a pound. Plastics made from the compound, while not so strong as some synthetic products now in use, are quite moisture resistant and would be suitable for moulding bathroom tiles for both floors and walls. They apparently have the wearing ability of wood and may be sanded and repolished through the entire body. The second method is hydrolysis in the presence of aniline, a coal tar derivative. The material cost of plastics from this process will be more, about a penny farthing a pound, but they are as strong as plastics now in use. In tests they have resisted bending pressures up to 9,000 lb. per sq. in. They are slightly less water-resistant than plastics made by the first method, but do not warp and may be sawed, drilled and, with care, nailed. These properties suggest uses as card tables, desk tops and building panels. Treating the bagasse with caustic soda and furfural is the third process. In quality, plastics from this method are about midway between the two. They flow better and mould at 2,500 lb. per sq. in., compared with 3,500 for the second treatment. They may be put to the same uses as the plastic from the second treatment. Either of the plastics made from the last two processes do not shatter easily. In fact, neither breaks when struck hard enough with a hammer to cause a dent, which is a very severe test.

Latex film for polishing aluminium is now recommended as a protective coating. When ordinary commercial latex is applied to polished aluminium, however, a bluish discoloration is produced which remains when the film of rubber is stripped off. Tests have been made at the United States Bureau of Standards to ascertain the cause of this discoloration and have indicated that it is produced not by the rubber, but by ammonia, which is almost universally employed as a preservative for latex. When the ammonia is removed by dialysis through a Cellophane membrane latex no longer discolours aluminium. Ammonia-free latex preserved by the addition of the requisite amount of pure formaldehyde is likewise inert. **Spraying powdered Thiokol on metal** is now being carried out by prominent engineering firms in America with the object of giving metal surfaces a continuous protective coating which firmly keys itself and stands up to severe treatment. Powdered Thiokol is sprayed on metal by the famous Schori gun which is marketed in the United States by the Schori Process Corporation.

THE AGE OF PLASTICS

Under the above title there was recently held in Paris an Exhibition devoted to Plastics. The posters announcing it temporarily eclipsed the racing notices.

WITH the enforced slimming treatment we have undergone owing to war conditions, we were compelled last month to hold over an article devoted to the French Exhibition recently held in Paris and entitled "The Age of Plastics."

Verily it is essentially an article for the piping times of peace for it gave to the world a very clear idea of how plastics have served Art and Industry. For this very reason, perhaps, we should turn to it, after the recent hectic days, with some relief and console ourselves that both Art and peace-time Industry will once again take up their proper stations in our scheme of things.

The exhibition was held at the *Maison de Chimie* while concurrently and at the same place were held a series of meetings at which was discussed a wide range of subjects under four general headings: Standardization, Manufacture, Tools for Manufactures, and Applications of Plastics.

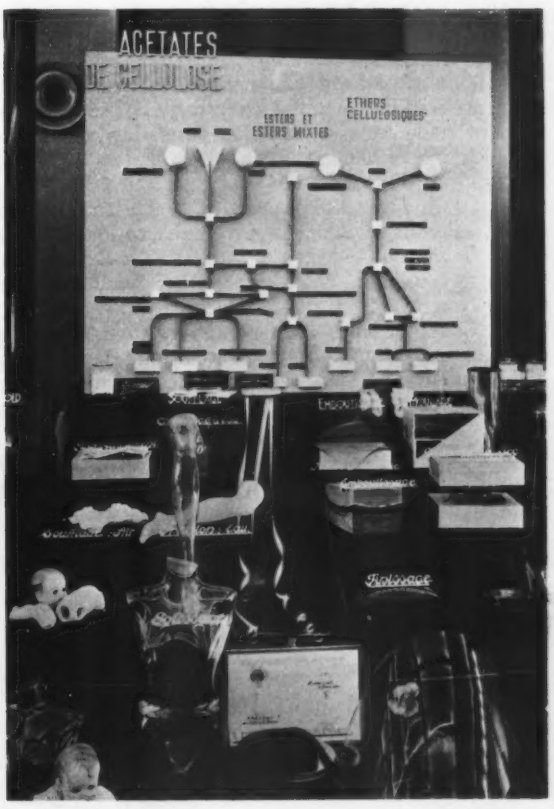
The *Maison de Chimie*, which is situated in Rue Saint-Dominique very near the Chamber of Deputies, is a very wonderful building; its lecture hall is certainly the most beautiful we have seen in any country. In this House of Chemistry, which appears to be an offshoot of the French Society of Chemical Industry, there often gather the industrial chemists of France and from time to time the industrial chemists of the world, to exchange views free from international complications.

What we find delightful about the French plastic industry is that it is not afraid of a bit of real publicity, that is, it tells the man in the street there is something worth while seeing in this new industry. We found large posters announcing the holding of the exhibition almost as widely distributed on the walls of Paris as those for any alcoholic beverage such as Dubonnet. This is perhaps a bit of an exaggeration, but still, they were distributed widely enough, and with good results, judging from the attendance of a goodly proportion of the general public. The posters, as will be seen from the photograph at the head of this page, portray an allegorical representation of Plastics, a hand emerging from the Earth (or is it the Sea?) and holding aloft

The entrance hall to the Exhibition. Most striking were the marble-like, yet translucent, columns and wall decorations of Cristaroc.

The Exhibition Hall at the *Maison de la Chimie* was divided into 10 sections, beginning on the left with phenol-formaldehyde resins and finishing on the right with the butadiene polymers (rubber-like synthetic resins). In the background is seen an illuminated coloured replica of the poster at the head of the first page.

This photograph of the amino-resin exhibit portrays the novel method of treatment adopted. The pictorial design at the back shows how the resins are manufactured. In the foreground are the finished materials made from amino-resins.



Similarly, this shows the origin of one of the cellulose plastics and the finished goods made from it. Here, too, were shown the different processes, moulding from powder, forming from sheet, air-blowing, polishing, slicing, etc., by which this material can be worked.

A corner of the "Acrylic" resin section. Note the beautifully sculptured piece.

what is obviously a moulded plastic form. Obviously, that is to the plastic-minded. We wonder, however, what the man in the street made of it. Nevertheless, it was a very attractive poster and the exhibition was crowded most of the time.

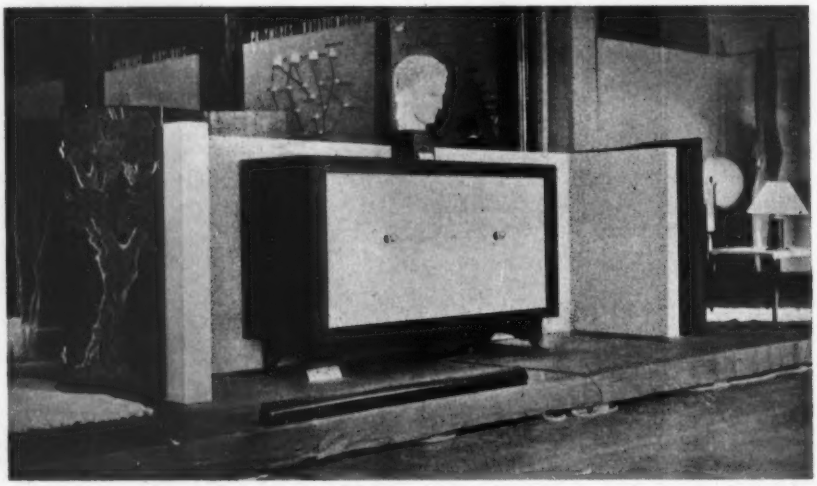
The most striking of the exhibits greeted one in the entrance hall itself, where what appeared to be a number of translucent marble columns, busts and wall decorations, illuminated from within a hollow, were on view. These are seen in one of the accompanying photographs and are made from a material possessing the trade name Cristaroc, the invention of Etlin, 153 Rue du Faubourg St.-Honoré. We were informed that Cristaroc is essentially cellulose acetate sheet incorporated with a siliceous material to give it the curious marble effect. It appears to bear a close relation to Cristaplem, which was used to decorate the Perfumery Pavilion at the New York Fair. (See *Plastics*, July, 1939, p. 230.) Cristaroc lends itself admirably to the making of diffused lighting tubes and architectural purposes, such as panels, balustrades, illuminated ceilings, vases, mirror frames, friezes and so on. We were also given to understand that it withstands considerable weathering and can be employed for exterior work, such as garden decoration. It is sad to think that this new material must vanish for the time being from the world of good and pleasant things.

Within the Exhibition Hall itself the entire range of plastics were on view in a very clear manner. The Hall itself was by no means large, in many ways a big advantage, for the various sections were therefore not large and all the divisions in the industry were visible to the onlooker by merely standing in the middle and turning on his heel. Each division, however, was extremely complete in itself and there were ten divisions. The exhibits consisted of a wall diagram showing the origin of each material and below it examples of the raw plastic material and the industrial substances and finished objects made from it. It seems a pity that such a general exhibit is not incorporated in the B.I.F.

The divisions were as follow:—

Coumarone and Indene Resins.—These are rarely mentioned in the literature other than chemical, for they are not employed as moulding powders. Nevertheless, they are an extremely important range of synthetic resins made from certain fractions obtained during coal-tar distillation. As they are polymers of hydrocarbons they are extremely neutral bodies and, unlike many other synthetic resins, cannot be saponified at all nor do they possess any acidity. They are, therefore, extremely resistant to the attacks of both acids and alkalis. They find application in very special paints such as those submitted to severe weathering and sea action, as insulating varnishes in condensers and transformers, as an ingredient for incorporating in rubber and improving it, as a binding agent for cork powder and linoleum; their use for incorporation in chewing gum has long been known.

Phenol-formaldehyde Resins.—The exhibit in this section was not only confined to mouldings, cast resins and laminated materials, but also included the very wide range of resins made from phenols for the paint industry, that is the linseed oil soluble type. In addition, the French appear to have developed the impregnation of wood very strongly, for there were shown some excellent examples of shoes for insulation purposes on electric railway lines, mechanical parts, driving wheels, aeroplane screws, etc. This wood-impregnating industry appears to have reached a stage much more advanced in France than it has in this country.



A lovely sideboard of cream-coloured laminated material, surmounted by a Cristaroc head. To the left is seen an inlaid screen.

Amino Resins.—Similarly a range of exhibits wider than is generally seen in Great Britain was shown in this section, for it included not only the urea formaldehyde resins used as glues, moulding powders and cast resins and as ingredients in oil varnishes, but also the lesser known aniline formaldehyde resins. Examples of these were shown for application in making laminated paper and moulding powders. They have excellent electrical properties, and France is, or at least was in peace time, manufacturing insulators of many types for electrical and radio components from them.

Cellulose Nitrate and Acetate.—France has always been one of the big producers of cellulose compounds, of artificial silk both as nitrate, asprammonium or acetate, of celluloid and of the acetate for making moulding powders and sheet. What is also important, France has long adapted herself to the manipulation of these materials, especially acetate sheet by moulding or rather forming and air blowing. The excellent examples of this type of work seen in one of the accompanying photographs, dolls, transparent "busts and legs" for hosiery and other window displays, show the high quality of the work. In recent years such processes have fortunately been introduced into this country. Here were also shown examples of ethyl, methyl and benzyl cellulose. Methyl cellulose is used as a non-putrescent glue and for water paints, while ethyls and benzyl celluloses find application in paints and varnishes.

Casein Plastics.—This industry has been a big one in France for 50 years or more, especially as the best casein for the purpose is made in that country. The beautiful objects for the fancy goods trade made from the material are too well known to need elaboration. Similar industries were introduced to this country by British Xylonite Co., Ltd., and Erinoid, Ltd.

"Acrylic" Resins.—The beauty and utility of these resins quickly attracted workers in France. Sheet and rod are widely used for aeroplane, motorcar, electrical and optical construction, while there is especially in France a big outlet for artistic ability in fashioning the material for decorative purposes. The sculptured piece seen in the accompanying photograph is a lovely example of what can be accomplished by an artist.

"Vinyl" Resins.—We were pleasantly surprised to note that several of this type are being produced in France. There are at least six large concerns that produce one or more of the following resins—polystyrene, polyvinyl, acetate, polyvinyl alcohols, polyvinyl chloride, polyvinyl acetals—in solid form for moulding or emulsion form for impregnating purposes. A very wide range of finished goods produced from these included injection moulded polystyrene for electrical purposes of the well-known type, artificial leather made from polyvinyl acetate, conveyor belts from polyvinyl alcohol, safety glass from polyvinyl acetals, and cables and waterproofed fabrics from polyvinyl chloride.

Alkyd Resins.—This well-known type made from glycerine and phthalic anhydride is used solely for incorporation in varnishes and lacquers and since they find no application in moulding are not discussed in detail here.

We must draw particular attention of the reader to the last photograph we publish. It shows an excellent example of the decorative possibilities of plastics. The sideboard was constructed of cream and black laminated sheet. On it rested a head made from the cellulose acetate plastic we have already mentioned, Cristaroc. To the left is seen a very beautiful four-leaved screen, again of laminated material, but decorated with an inlaid design of trees in appropriate colours.

WAR-TIME ORDER FORM

Due to restrictions made necessary by war, it is unlikely that newsagents in all districts will have copies of "Plastics" available for the casual purchaser.

Should you wish, therefore, to make sure of getting your copy of "Plastics" regularly, you are strongly recommended to complete the form herewith and hand it to your newsagent.

There is definitely more reason now than ever why "Plastics" should be regularly read by you. Not only will it keep you in touch with the many regulations and control measures being issued from time to time, but it will also give advice and informative comment upon them.

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PRODUCTION

Practical Information dealing with Raw Materials, Moulding and Forming of all types of Plastics—Thermo-Hardening and Thermo-Plastic—Works-Organization, New Plant and Control Apparatus

NOTES AND COMMENTS

Control of Export and Import

THE following materials of interest to the plastics industry are prohibited to be exported from the United Kingdom. The letters refer to the destination to which export is prohibited. A means all destinations. B means any port or destination not being a port or destination in some part of His Majesty's dominions, in a British protectorate, in any country or territory under His Majesty's protection or suzerainty, or in a territory (other than Palestine and Transjordan) in respect of which a mandate on behalf of the League of Nations has been accepted by His Majesty and is being exercised by the Government of any part of His Majesty's dominions. C means all destinations in foreign countries in Europe and on the Mediterranean and Black Seas, other than France and French possessions, and all ports in any such foreign countries.

1. Raw materials and articles mainly unmanufactured.
   - Abrasives, crude or partly manufactured:—
     - Natural, corundum, emery and garnet ..... A
     - Artificial, silicon carbide, aluminium oxide, including alundum and aloxite ..... A
   - Asbestos, raw and fibre C
   - Graphite ..... A
   - Mica ..... A
   - Lead ..... A
   - Nickel ..... A
   - Veneers ..... A
   - Raw cotton, linters, pulp, pulp-board, cotton waste C
   - Rubber, including compounded rubber, vulcanite, balata gutta-percha and scrap ..... B
2. Articles wholly or mainly manufactured.
   - Abrasive wheels, etc., or manufactured abrasive bonded together with other material ..... A
   - Lead, pigs, ingots, etc. ..... A
   - Nickel and its alloys, ingots, cathodes, shot, etc. A
   - X-ray valves and parts thereof ..... A
   - Wireless valves and parts thereof ..... A
   - Plywood ..... A
   - Wood flour ..... A
   - Acetone, methyl, ethyl and butyl alcohols, ammonia compounds, aniline, cellulose esters and ethers, benzol, toluol, carbolic acid, cresylic acid, formaldehyde, glycerine, rubber accelerators, anti-oxidants, synthetic substitutes for uncoloured glass, gramophone records ..... A

Importation of goods on the following list is prohibited, except under licence issued by the Import Licensing Department of the Board of Trade. We include in it objects which may be partly made of plastics.

- Electric light fittings and accessories: Brackets, candelabra, ceiling roses, fuse-holders and bases, fuse and distribution boxes, lamp-holders, shades and reflectors, switches, table and floor standards.
- Office machinery: Typewriters, accounting machines.
- Hair-waving machines and parts thereof.
- Vacuum cleaners.
- Chemicals: Collodion, synthetic organic dyestuffs and intermediates for dyestuffs, luminous paints and luminous powders.
- Rubber manufactures.
- Miscellaneous: Smokers' ash receptacles, cigarette cases and boxes, inkstands, linoleum, buttons, slide fasteners, studs, buckles, powder bowls, denture bowls, manicure sets, toys, umbrellas and parts thereof.

Inquiries regarding import licences should be addressed to the Import Licensing Department, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

Electric Hand Lamps for A.R.P.

The third specification in the series of A.R.P. British Standard Specifications has just been published. This specification (BS/ARP 3) is for electric hand lamps (fitted with primary battery or unspillable accumulator), and was prepared at the request of the Air Raid Precautions Department of the Home Office.

The specification relates to the design and construction of electric hand lamps for general use out of doors or in buildings in which the windows, roof lights, etc., are not screened. It will be obvious that the ordinary torch type of hand lamp would not be suitable for use in such conditions as no means are provided for preventing the light rays being directed upwards. The specification which has just been issued requires that the design of the hand lamp shall be such that the light emitted is properly directed and screened.

Copies of this specification can be obtained from the British Standards Institution, 28, Victoria Street, Westminster, S.W.1, price 3d. per copy.

The London Shellac Research Bureau

After a short period on the outbreak of hostilities to reorganize the Lac Research Laboratory, this laboratory has reopened in the Chemical Engineering Department of University College, Gower Street, London, W.C.1, from Monday, September 25, 1939. The work of the Special Officer Lac Inquiry has continued, and will continue, at India House, Aldwych, London, W.C.2.

TRADE AND PERSONAL NOTES

Alfred Herbert, Ltd., Coventry, have sent us the latest issue of *Machine Tool Review*, which contains a detailed survey of the Daniels moulding presses and equipment for the plastics industry. The range includes the 50-ton hydraulic upstroke press; 50-75-ton hydraulic prefilling type downstroke press; single-punch preforming machine; rotary preforming machine; 500-ton hobbing press; rotary preforming machine feed box and agitator gear and single-lever poppet-type valve for high pressure, low pressure and release. One of the most interesting of the Daniels machines now handled by Alfred Herbert, Ltd., is the hobbing press. This is made in 5 sizes from 500 to 3,000 tons. A master hob of special tough steel is made in the exact shape of the finished article to be moulded. This hob is pressed cold into a soft steel blank and produces a cavity or mould which becomes one of a number to be fitted into a bolster or chase after case-hardening and polishing. The upper surface of the blank is highly polished and on this is placed the master hob. The press is then slowly closed until the base of the master just touches the upper hardened table. The press guards are then closed and the hobbing proceeds slowly until the required depth of cavity is obtained. The pressures required when hobbing are approximately 100 tons per square inch on the master when hobbing into a soft steel, such as ordinary mild steel, on fairly shallow cavities. On deeper cavities the pressure may be 200 tons per square inch or more; the blank may have to be annealed once or twice and the hobbing consequently carried out in stages. Some types of nickel steels can be hobbed and pressures are then about one and a half times the above figures. Substantial steel plate guards are provided to protect the operator in the event of the hob splitting under pressure.

British Thermostat Co., Ltd., Windmill Road, Sunbury - on - Thames, Middlesex, have sent us their publication 355 A describing their well-known duo-point control.

Kork-N-Seal, Ltd., have transferred their head office to 7, Lauriston House, Bickley Park Road, Bickley, Kent (Phone, Chislehurst 1009), to which address all communications should be sent.

Venner Time Switches, Ltd., Kingston By-pass Road, New Malden, Surrey, have forwarded us a copy of their brochure dealing with type VDB dual coin meter.

Britain's Electric Motors Co., forwarded us a new booklet dealing with single and polyphase motors.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, have just published a comprehensive guide to their range of Osram valves.

Trading with the Enemy Branch (Treasury and Board of Trade), Western Galleries, Imperial Institute, Exhibition Road, South Kensington, London, S.W.7, will deal with all inquiries from interested parties. The term enemy covers (a) Governmental agencies in enemy territory, (b) any person or business resident or established in enemy territory, (c) any branch (in any country) controlled from a principal place of business in enemy territory, and (d) any company or other body of persons which is constituted or incorporated under enemy law.

Sterling Manufacturing Co., Ltd., 166, Piccadilly, W.1, have introduced an electric torch of novel construction which should prove of great service to factory workers. It is constructed entirely of rubber and will, therefore, stand up to very rough usage, and it is practically impossible to damage it accidentally. For electrical work the torch has the advantage that it is shockproof and short circuits cannot be accidentally caused. In addition, the torch is claimed to be watertight and can be used under water.

The British Xylonite Co., Ltd., have forwarded us a copy of their general catalogue which contains descriptions of their comprehensive range of Halex ware and also a copy of their catalogue describing their comprehensive selection of dressing cases.

Institute of the Plastics Industry. All meetings are cancelled for the present.

General Plastics, Inc., 97, Walck Road, North Tonawanda, N.Y., U.S.A., have forwarded us a copy of *Durez Moulded* which, as usual, contains a number of interesting items for plastics manufacturers. Some account is given of the Radiolar developed by E. A. Myers and Sons, which has 14 moulded Durez plastic parts. Largest of these is the battery case moulded in two parts. Smallest pieces are the miniature switch plugs, also moulded in two parts. These mouldings range in size from 3½ ins. by 2½ ins. for a half section of the battery case to $\frac{5}{16}$ ins. by ⅛ ins. by 3-32 ins. for the smallest part of the switch plug. Every piece is a precision job. Minute guide ribs, small bosses, connector plug holes must not vary a fraction. Small brass inserts must be securely moulded-in. As parts of the unit are in continuous contact with user's body, the surface must be smooth and not affected by body heat or acids.

Mr. Windsor, of Technical Machines and Accessories, 17, Finsbury Square, E.C.2, tells us that, in addition to holding some stock, he is making the well-known Eckert and Ziegler injection moulding machines in this country.

Cambridge Instrument Co., Ltd., 13, Grosvenor Place, London, S.W.1, have just published sheet No. 11-C describing their new apparatus for the direct reading of pH. This portable pH meter should be of interest to those in the plastics industries who have their own laboratories.

The British Xylonite Co., Ltd., announce, in a communication dated September 21, that, as from that day, all invoices will be subject to a surcharge of 5 per cent., but this surcharge will not apply to invoices for goods the orders for which were accepted prior to the date of the circular, nor will it apply to Halex toothbrushes. This increase in price has been decided upon to cover increased expenditure due to war risks insurance, A.R.P. and packing materials, etc. It is also announced that the British Xylonite Co., Ltd., hoped to be able to issue an interim price list in the course of the next week or so, in which the net prices to retailers will be shown. The prices in this list will incorporate the 5 per cent. now announced and also any adjustments it may be necessary to make in the prices of individual lines. All such prices will be subject to a discount to the wholesale trade, the amount of which will be announced.

Change of Address

Thomas De La Rue and Co., Ltd., Avenue Works, Walthamstow Avenue, E.4.

Bakelite, Ltd., have removed from Hobart House, 40, Grosvenor Place, S.W.1, to Brackley Lodge, Brackley, Northamptonshire. Telephones: Brackley 144 and 145. Telegrams: Bakelite, Brackley, Northants. The London offices are closed. Sales representatives will be located in different parts of the country.

Obituary

We regret to announce the death of Major H. C. Parkes, O.B.E., Managing Director, Thomas De La Rue, Ltd., on September 26. It will be remembered that Major Parkes was Chairman of The British Plastics Federation, 1938-39, and took a very prominent part in the affairs of the industry.

NEW MATERIALS—NEW PLANT—NEW METHODS

The Royle Extruding Machine

SOME years ago, in the comparatively simple manufacture of casein buttons, the Royle extruding machine first gained favour with the industry. The feed screw of a standard rubber extruder was altered slightly to compress and carry forward the casein compound more efficiently. Soon other producers of plastics turned to Royle and, before long, standard Royle rubber machinery was in use in the leading plastics plants, the vagaries of such compounds as cellulose nitrate being controlled by running at slow speeds through auxiliary gear reduction equipment.

Through the use of Royle extruding machines, continuous extrusion of resin compounds is successfully accomplished using feed screws and die heads substantially the same as those long used for rubber.

The screw type extruder consists briefly of a cylinder through which a specially designed conveyor screw carries material fed into one end of the cylinder to and through a die at the opposite end. The screw thoroughly masticates and compresses the compound and the product emerges in continuous lengths. The form of the die determines the shape of the product.

The machine is used to make rods, tubes and channels; to insulate wire and to cover hose and rollers. The extruding machine is also used to remove particles of foreign matter from stocks by straining them through mesh wire or gauze.

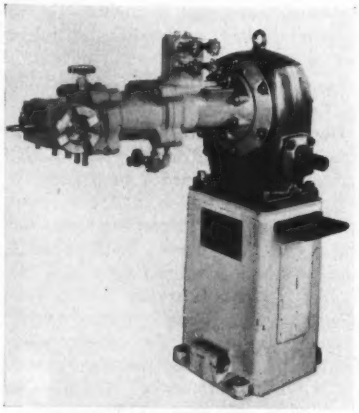
The design of Royle extruding machines includes many refinements promoting speed and quality in production together with long machine life and low maintenance cost. Power is applied through a flexible coupling from the motor which is securely mounted on a sturdy base solidly connected and aligned with the machine. The two smallest extruders utilize multiple V-belt coupling between motor and gear unit. Gear reduction is by fully enclosed worm or compound herringbone gears, running on anti-friction bearings, self lubricated. Feed screw thrust is absorbed by an adequate roller bearing. The screw shoulder bearing is of hard bronze.

Royle cylinders are step-cored for positive circulation of steam, water or other media used for temperature control. Heads are also cored. For rubber, the machine is furnished with an assembly of valves, on top of the cylinder facing the operator, for controlling the head and cylinder separately.

Basically the Royle resin head is a die-supporting member where the plastic material—having been brought forward through the cylinder by the feed screw—is forced through the forming die. In this head, the Royle concern have incorporated adequate passages for the circulation of hot oil and the die-holder is cored to allow temperature control at the very mouth of the die.

For use with the resin head, a special jacketed cylinder extension and correspondingly longer feed screw are available to provide a longer compression and heating period for the compound. In covering wire or other forms, the form is introduced into the head at right angles to the cylinder, passing through the head and emerging from the die at the opposite side.

This new Royle resin die head is being used with excellent results in the production of resin-covered wire. Its future usefulness no doubt includes the continuous extrusion of rods, tubes, channels and other solid or hollow forms such as are fabricated on standard Royle machines in the rubber industry.

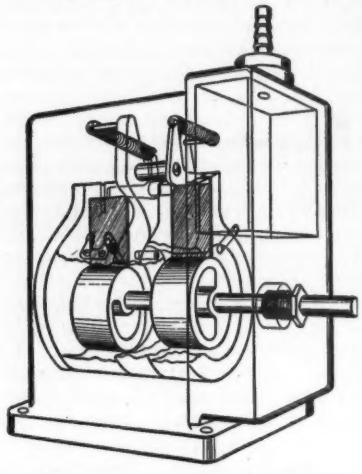


The Royle extruding machine.

The manufacturers of the machine are John Royle and Sons, Paterson, New Jersey, and it is handled in this country by James Day (Machinery), Ltd., 46, Southampton Row, London, W.C.1.

Rotary Pumps for High Vacuum.

We have just received particulars of the well-known Cenco range of vacuum pumps, including the famous Hyvac, of which there are 14,000 in use, manufactured by W. Edwards and Co., Allendale Works, Southwell Road, Loughboro' Junction, London, S.E.5. All the Cenco pumps are well known for their quiet working and absolute reliability even under adverse conditions. They are practically indestructible, are unaffected by mercury vapour and therefore can be readily used for backing diffusion pumps. Either the pump with pulley and charge of oil can be supplied or the complete outfit, i.e., the pump mounted on base with motor, pulleys, belt and oil, ready for use. They can be used for any application of high vacuum work, but W. Edwards and Co. will be pleased to advise where probable users are not sure of the most suitable type. As the construction of these pumps is somewhat different



Diagrammatic drawing of a Hyvac pump.

from other types, the following general description is given. The illustration shows a Hyvac pump consisting of two distinct rotary units. These are arranged in series on a common horizontal shaft immersed in an outer metal case filled with very low vapour pressure oil. This oil ensures proper lubrication and only the recommended grade should be used. A charge is supplied free with each pump. A simple internal oil trap is embodied in each pump.

Specification of Two-stage Hyvac Pump

Vacuum, mm.Hg.	0.0004
Displacement, cubic ft. per min.	0.35
Displacement, litres per min.	10
Speed of pump, r.p.m. ...	350
H.P. of motor	¼
Speed of motor, r.p.m. ...	1,425
Oil charge, English gallons ...	¼

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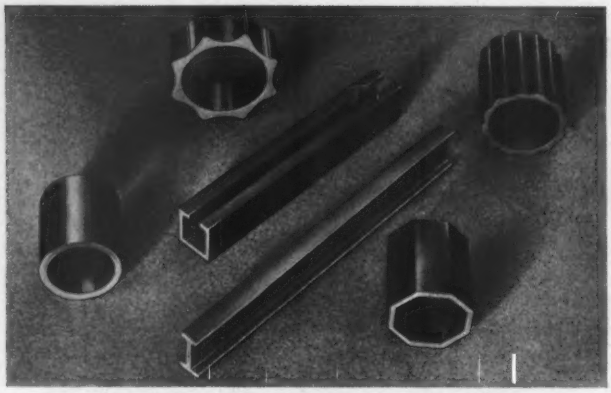

Extruded sections in a variety of forms and shapes.

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Whilst every precaution is taken to ensure accurate printing, the publishers will not be responsible for printers' errors, or for errors arising out of telephonic instructions relating to advertisement copy; nor will they be responsible for advertisement blocks destroyed by fire or that are left in their possession for more than one year.

REGULATIONS.—Copy must be supplied without application from the publishers, and current copy and blocks will be repeated if new copy is not received at the time for closing for press. Orders for advertisements are subject to acceptance in writing from the Head Offices. Advertisement copy is subject to the approval of the publishers. All advertisements and contracts are accepted and made upon the express condition that the publishers have the absolute right to refuse to insert copy to which they may object for legal, public or trade reasons, which includes the right of rejection of advertisements, whole or part, containing cut prices of goods coming under an approved price maintenance scheme, and such refusal of copy shall not be a good ground for advertisers to stop a current contract or to refuse to pay for the same, or for taking action for breach of contract. The Proprietors, whilst endeavouring to ensure that advertisements shall appear with all possible regularity, will not be held liable for any loss occasioned by the failure of any advertisement to appear from any cause whatever. The acceptance of an order does not confer the right to renew upon similar terms. Contracts relate to the advertiser's own goods or services, and the space may not be sub-let or disposed of in any way. Conditions which are contained in order forms other than those of the Proprietors, and which do not conform to, or are in addition to, the Proprietors' conditions, will not be recognized as binding. Special conditions must be subject to mutual agreement.

REMITTANCES.—Postal orders, cheques, etc., should be made payable to Temple Press Ltd., and crossed "Midland Bank, Ltd., Bedford Row." Remittances from abroad should be made by International Money Order in Sterling.

TERMS.—Monthly accounts, strictly net; due when rendered.

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All Editorial communications and copy should be addressed to the Editor, and must reach him not later than the 24th of the month for the next issue. MSS. or drawings which are not considered suitable will be returned if stamps are enclosed, but the Editor does not hold himself responsible for the safe keeping or the safe return of anything submitted for his consideration.

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